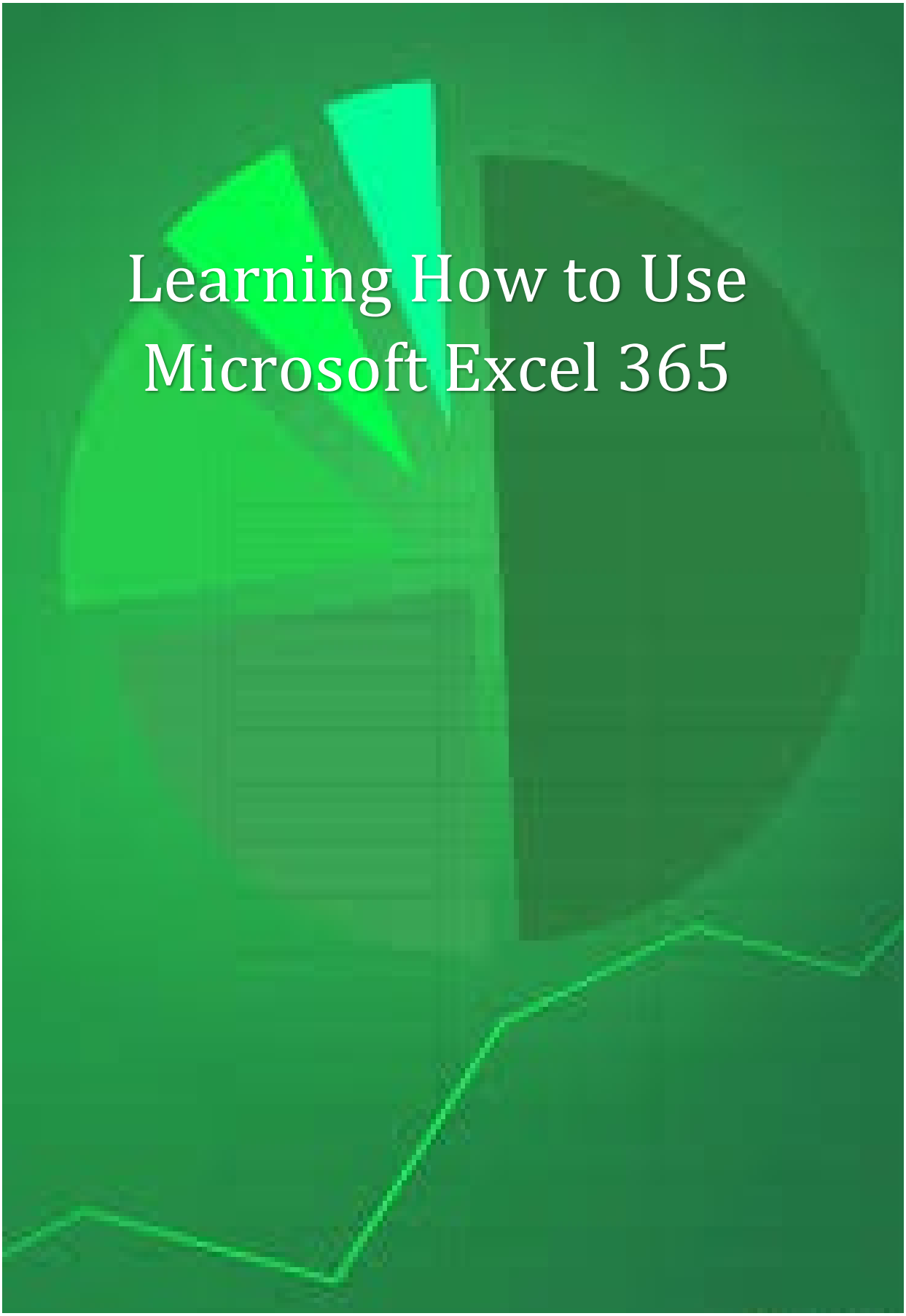

Learning How to Use
Microsoft Excel 365

Preface

This core Microsoft® Excel® text provides students with the skills needed to execute many personal and professional activities. It also prepares them to go on to more advanced skills using the Excel software. The text takes the approach of creating Excel worksheets that are accurate, tell a story, and can be helpful in making decisions. Personal decisions introduced include important purchases, such as homes and automobiles, savings for retirement, and personal budgets. Professional decisions include budgets for managing expenses, merchandise items to mark down or discontinue, and inventory management. Students are given clear, easy-to-follow instructions for each skill presented and are also provided with opportunities to learn additional skills related to the personal or professional objectives presented. For example, students learn the key terms with respect to home mortgages and understand the impact interest rates have on monthly mortgage payments. This text also places an emphasis on "what-if" scenarios, so students gain an appreciation for the computational power of the Excel application. In addition, students learn how Excel is used with Microsoft® Word® and Microsoft® PowerPoint® to accomplish a variety of personal and professional objectives.

There are many versions of Excel students may be using. The screenshots in this book may not look exactly like the version you are using. There are too many versions to create screenshots for each version available.

All screenshots that appear throughout this text are copyright of Microsoft Corporation. All Rights Reserved. They have been used with permission from Microsoft Corporation.

Learning How to Use Microsoft® Excel® is an independent publication and is not affiliated with, nor has it been authorized, sponsored, or otherwise approved by Microsoft Corporation.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Contents

Preface 2
Chapter 1 5
Fundamental Skills 5
1.1 An Overview of Microsoft® Excel® 5
1.2 Entering, Editing, and Managing Data 20
1.3 Formatting and Data Analysis 42
1.4 Data Alignment 48
1.5 Simple Chart 57
1.6 Printing 72
Chapter Assignments and Tests 79
Chapter 2 88
Mathematical Computations 88
2.1 Formulas 88
2.2 Dynamic Arrays 104
2.3 Statistical Functions 109
2.4 Functions for Personal Finance 131
Chapter Assignments and Tests 170
Chapter 3 186
Logical and Lookup Functions 187
3.1 Logical Functions 188
3.2 Statistical IF Functions 228
3.3 Data Validation 255
3.4 XLOOKUP Function 263
Chapter Assignments and Tests 276
Chapter 4 300
Presenting Data with Charts 300
4.1 Choosing a Chart Type 300
4.2 Formatting Charts 336
4.3 The Scatter Chart 360
4.4 Using Charts with Microsoft® Word® and PowerPoint® 375
Chapter Assignments and Tests 384
Chapter 5 399

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Tables and PivotTables 399
5.1 Creating an Excel Table 399
5.2 Sorting and Filtering Data 407
5.3 Filtering Data 415
5.4 Structured Table References 420
5.5 Subtotals 422
5.6 PivotTables and PivotCharts 430
Chapter Assignments and Tests 447
Chapter 6 453
Dynamic Array Functions 453
6.1 SEQUENCE 453
6.2 UNIQUE 454
6.3 SORT 458
6.4 FILTER 459
Solver 463
6.5 SUMPRODUCT 464
6.6 Creating the Solver Model 465
6.7 Transportation Problem in Excel 471
6.8 Interpreting the Answer Report 475
Chapter Assignments and Tests 477
Legacy Excel Functions 481

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Chapter 1

Fundamental Skills

Microsoft® Excel® is a tool that can be used in virtually all careers and is valuable in both professional and personal settings. Whether you need to keep track of medications in inventory for a hospital or create a financial plan for your retirement, Excel enables you to do these activities efficiently and accurately. This chapter introduces the fundamental skills necessary to get you started in using Excel. You will find that just a few skills can make you very productive in a short period of time.

1.1 An Overview of Microsoft® Excel®

LEARNING OBJECTIVES
1. Examine the value of using Excel to make decisions.
2. Learn how to start Excel.
3. Become familiar with the Excel workbook.
4. Understand how to navigate worksheets.
5. Examine the Excel Ribbon.
6. Become familiar with the Quick Access Toolbar.
7. Examine the right-click menu options.
8. Become familiar with the commands in the File tab.
9. Learn how to save workbooks.
10. Examine the Status Bar.
11. Become familiar with the features in the Excel Help window.

Microsoft® Office contains a variety of tools that help people accomplish many personal and professional objectives. Microsoft Excel is perhaps the most versatile and widely used of all the Office applications. No matter which career path you choose, you will likely need to use Excel to accomplish your professional objectives, some of which may occur daily. This chapter provides an overview of the Excel application along with an orientation for accessing the commands and features of an Excel workbook.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

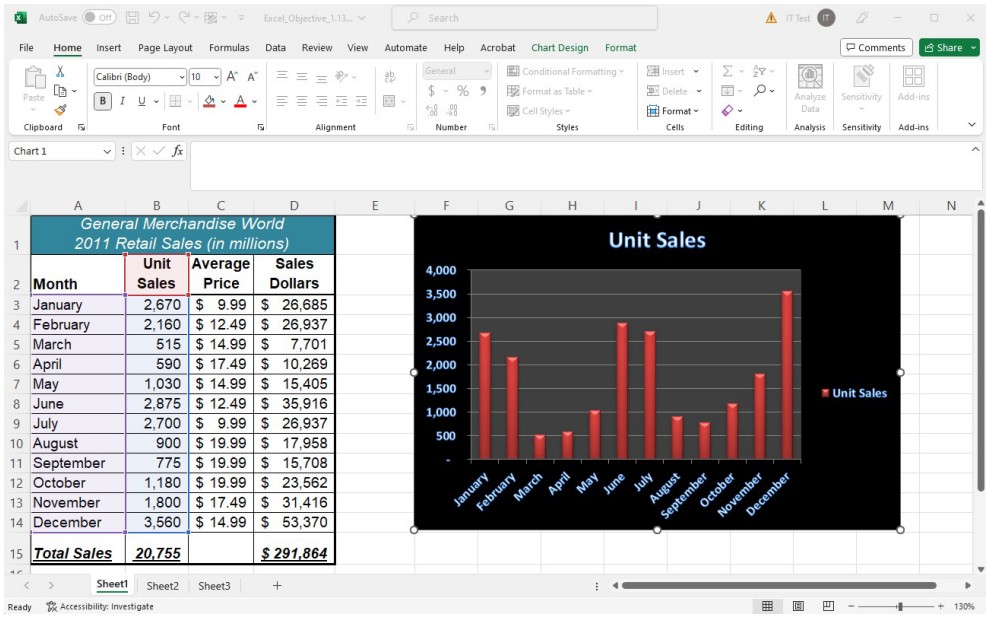
Making Decisions with Excel

Follow-along file: Not needed for this skill.

Taking a very simple view, Excel is a tool that allows you to enter quantitative data into an electronic spreadsheet to apply one or many mathematical computations. These computations ultimately convert that quantitative data into information. The information produced in Excel can be used to make decisions in both professional and personal contexts. For example, employees can use Excel to determine how much inventory to buy for a clothing retailer, how much medication to administer to a patient, or how much money to spend to stay within a budget. With respect to personal decisions, you can use Excel to determine how much money you can spend on a house, how much you can spend on car lease payments, or how much you need to save to reach your retirement goals. We will demonstrate how you can use Excel to make these decisions and many more throughout this text.

Figure 1.1 "Example of an Excel Worksheet with Embedded Chart" shows a completed Excel worksheet that will be constructed in this chapter. The information shown in this worksheet is top-line sales data for a hypothetical merchandise retail company. The worksheet data can help this retailer determine the number of salespeople needed for each month, how much inventory is needed to satisfy sales, and what types of products should be purchased. Notice that the embedded chart makes it very easy to see which months have the highest unit sales.

Figure 1.1 Example of an Excel Worksheet with Embedded Chart



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

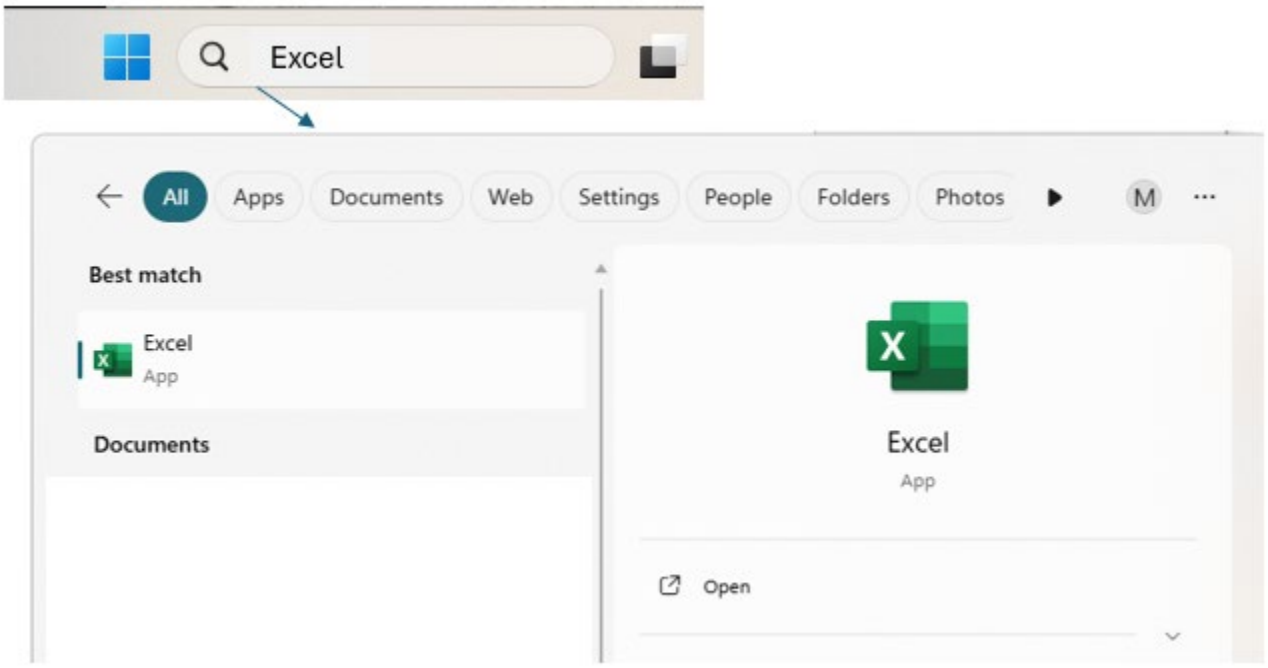
Starting Excel

Follow-along file: Not needed for this skill.

The following steps will guide you in starting the Excel application. Note that these steps along with Figure 1.2 "Start Menu" relate to the Windows 11 operating system.

1. Click in the Search box in the toolbar at the bottom of your screen
2. Start typing Excel. You will see Excel pop up as an option.
3. Click the Excel App. This will start the Excel application.

Figure 1.2 Start Menu



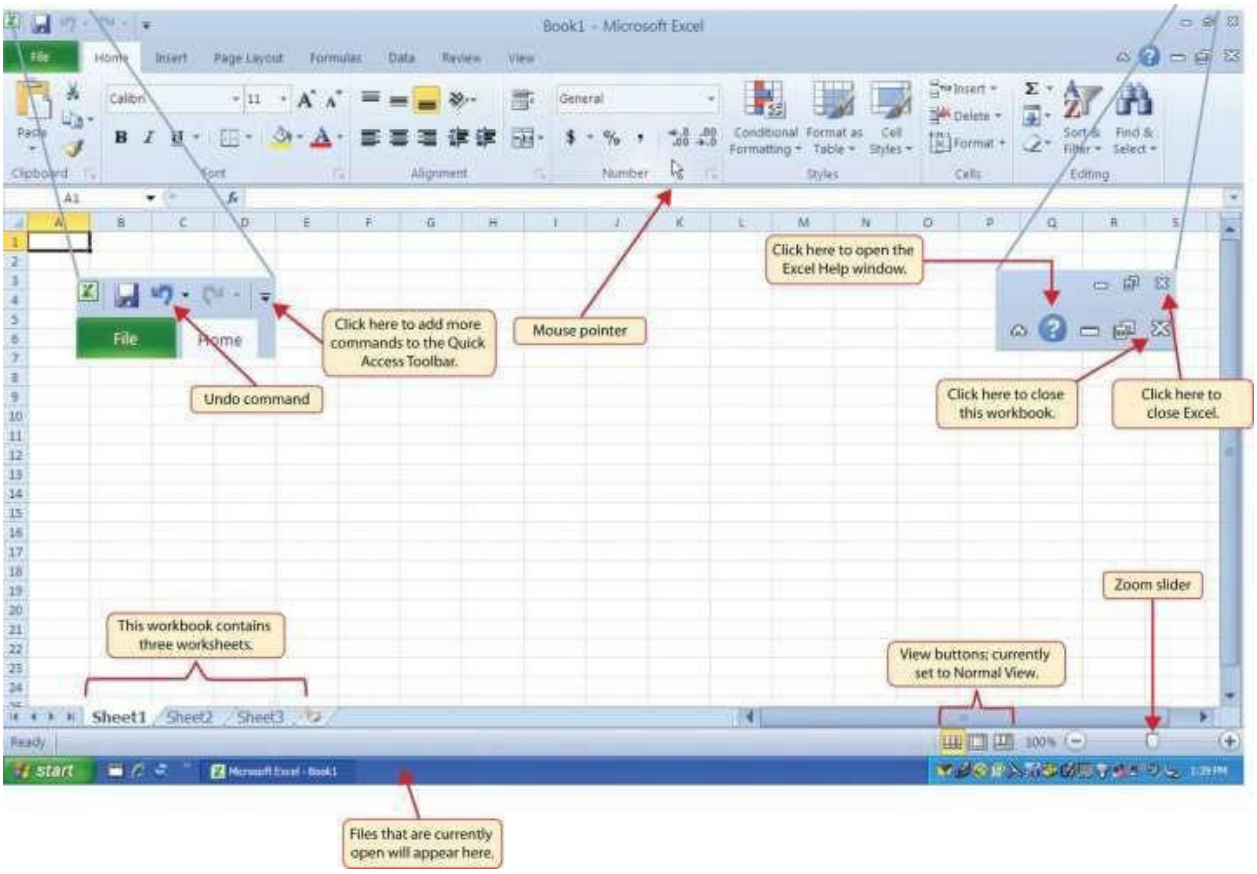
The Excel Workbook

Follow-along file: Not needed for this skill

Once Excel starts, a blank workbook will open on your screen. A workbook is an Excel file that contains one or more worksheets (sometimes referred to as *spreadsheets*). Excel will assign a file name to the workbook, such as Book1, Book2, Book3, and so on, depending on how many new workbooks are opened. Figure 1.3 "Blank Workbook" shows a blank workbook after starting Excel.

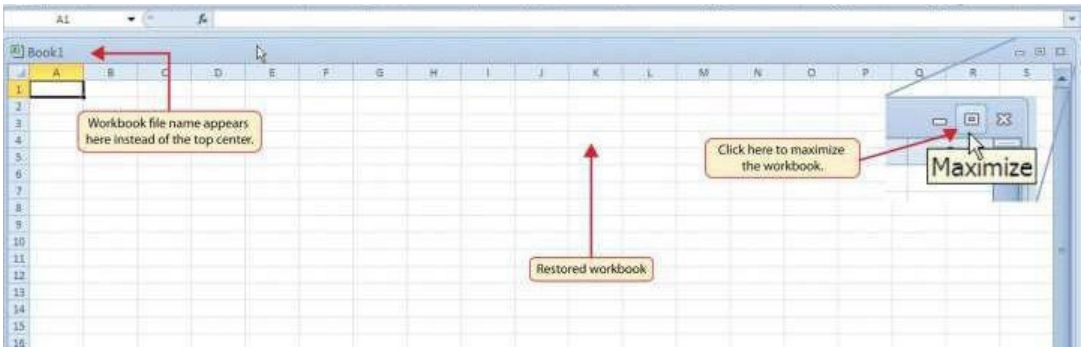
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 1.3 Blank Workbook


Book1 - Microsoft Excel
Click here to add more commands to the Quick Access Toolbar.
Mouse pointer
Click here to open the Excel Help window.
Undo command
Click here to close this workbook.
Click here to close Excel.
Zoom slider
This workbook contains three worksheets.
View buttons; currently set to Normal View.
Files that are currently open will appear here.

Your workbook should already be maximized (or shown at full size) once Excel is started, as shown in Figure 1.3 "Blank Workbook". However, if your screen looks like Figure 1.4 "Restored Worksheet" after starting Excel, you should click the Maximize button, as shown in the figure.

Figure 1.4 Restored Worksheet


Book1
Workbook file name appears here instead of the top center.
Click here to maximize the workbook.
Maximize
Restored workbook

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

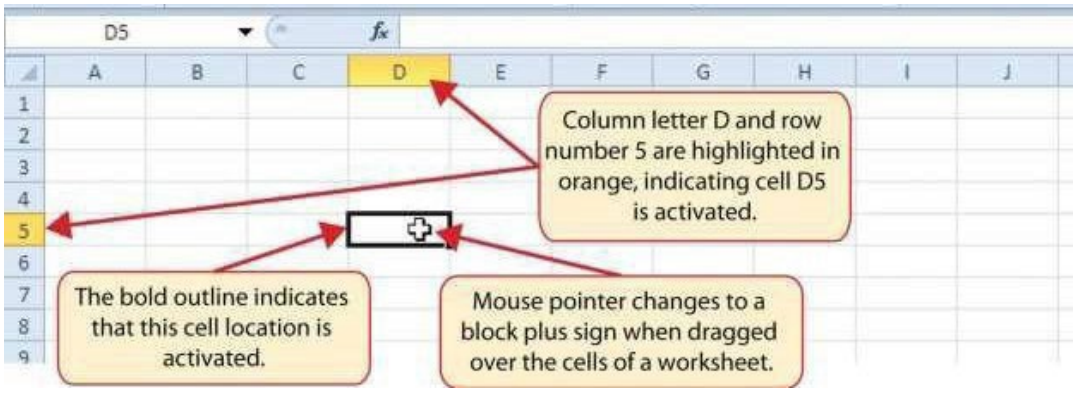
Navigating Worksheets

Follow-along file: Not needed for this skill.

Data are entered and managed in an Excel worksheet. The worksheet contains several rectangles called cells for entering numeric and nonnumeric data. Each cell in an Excel worksheet contains an address, which is defined by a column letter followed by a row number. For example, the cell that is currently activated in Figure 1.4 "Restored Worksheet" is **A1**. This would be referred to as cell location **A1** or cell reference A1. The following steps explain how you can navigate in an Excel worksheet:

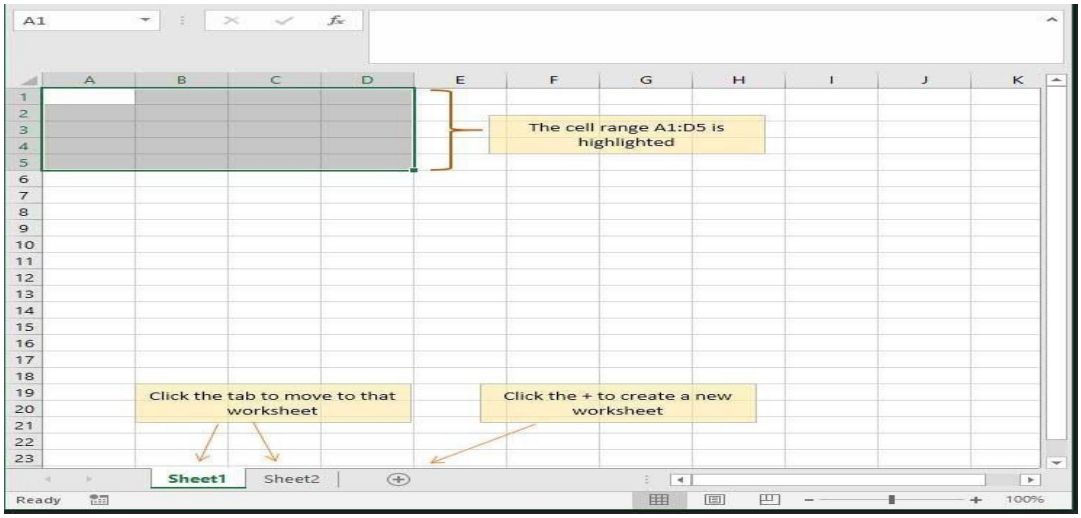
1. Place your mouse pointer over cell D5 and left click. Check to make sure column letter D and row number 5 are highlighted in gray, as shown in Figure 1.5 "Activating a Cell Location".
2. Move the mouse pointer to cell A1.
3. Click and hold the left mouse button and drag the mouse pointer back to cell D5.
4. Release the left mouse button. You should see several cells highlighted, as shown in Figure 1.6 "Highlighting a Range of Cells". This is referred to as a cell range and is documented as follows: A1:D5. Any two cell locations separated by a colon are known as a cell range. The first cell reference is the top left corner of the range, and the second cell reference is the lower right corner of the range.

Figure 1.5 Activating a Cell Location


D5
Column letter D and row number 5 are highlighted in orange, indicating cell D5 is activated.
The bold outline indicates that this cell location is activated.
Mouse pointer changes to a block plus sign when dragged over the cells of a worksheet.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 1.6 Highlighted Range of Cells



5. Click the + in the circle to create a new worksheet. Excel 2016 comes with only 1 worksheet in a new workbook.
6. Click the Sheet2 worksheet tab at the bottom of the worksheet. This is how you open a worksheet within a workbook.
7. Click the Sheet1 worksheet tab at the bottom of the worksheet to return to the worksheet shown.

Keyboard Shortcuts - Basic Worksheet Navigation
1. Use the arrow keys on your keyboard to activate cells on the worksheet. 2. Hold the SHIFT key and press the arrow keys on your keyboard to highlight a range of cells in a worksheet. 3. Hold the CTRL key while pressing the PAGE DOWN or PAGE UP keys to open other worksheets in a workbook.

The Excel Ribbon

Follow-along file: Not needed for this skill.

Excel's features and commands are found in the Ribbon, which is the upper area of the Excel screen that contains several tabs running across the top. Each tab provides access to a different set of Excel commands. Figure 1.7 "Ribbon for Excel" shows the commands available in the Home tab of the Ribbon. Table 1.1 "Command Overview for Each Tab of the Ribbon" provides an overview of the commands that are found in each tab of the Ribbon.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 1.7 Ribbon for Excel

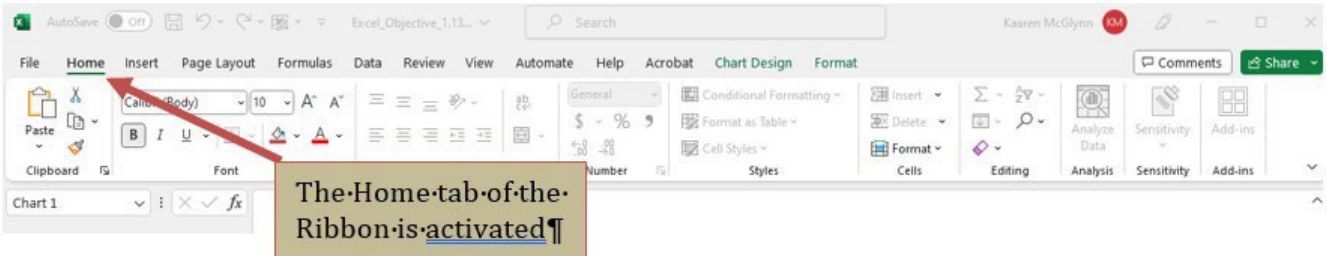


Table 1.1 Command Overview for Each Tab of the Ribbon

Tab Name	Description of Commands
File	Also known as the Backstage view of the Excel workbook. Contains all commands for opening, closing, saving, and creating new Excel workbooks. Includes print commands, document properties, e-mailing options, and help features. The default settings and options are also found in this tab.
Home	Contains the most frequently used Excel commands. Formatting commands are found in this tab along with commands for cutting, copying, pasting, and for inserting and deleting rows and columns.
Insert	Used to insert objects such as charts, pictures, shapes, PivotTables, Internet links, symbols, or text boxes.
Page Layout	Contains commands used to prepare a worksheet for printing. Also includes commands used to show and print the gridlines on a worksheet.
Formulas	Includes commands for adding mathematical functions to a worksheet. Also contains tools for auditing mathematical formulas.
Data	Used when working with external data sources such as Microsoft® Access®, text files, or the Internet. Also contains sorting commands and access to scenario tools.
Review	Includes Spelling and Track Changes features. Also contains protection features to password protect worksheets or workbooks.
View	Used to adjust the visual appearance of a workbook. Common commands include the Zoom and Page Layout view.

The Ribbon shown in Figure 1.7 "Ribbon for Excel" is full, or maximized. The benefit of having a full Ribbon is that the commands are always visible while you are developing a worksheet. However, depending on the screen dimensions of your computer, you may find that the Ribbon takes up too much vertical space on your worksheet. If this is the case, you can minimize the Ribbon by clicking the button shown in Figure 1.7 "Ribbon for Excel".

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

When minimized, the Ribbon will show only the tabs and not the command buttons. When you click on a tab, the command buttons will appear until you select a command or click anywhere on your worksheet.

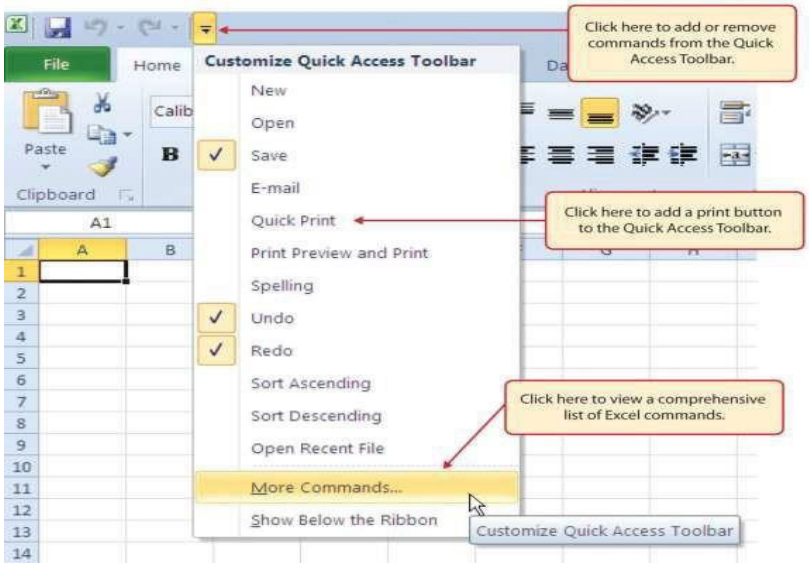
Keyboard Shortcuts - Minimizing or Maximizing the Ribbon
1. Hold down the CTRL key and press the F1 key
2. Hold down the CTRL key and press the F1 key again to maximize the Ribbon

Quick Access Toolbar and Right-Click Menu

Follow-along file: Not needed for this skill.

The Quick Access Toolbar is found at the upper left side of the Excel screen above the Ribbon, as shown in Figure 1.3 "Blank Workbook". This area provides access to the most frequently used commands, such as Save and Undo. You also can customize the Quick Access Toolbar by adding commands that you use on a regular basis. By placing these commands in the Quick Access Toolbar, you do not have to navigate through the Ribbon to find them. To customize the Quick Access Toolbar, click the down arrow as shown in Figure 1.8 "Customizing the Quick Access Toolbar". This will open a menu of commands that you can add to the Quick Access Toolbar. If you do not see the command you are looking for on the list, select the More Commands option.

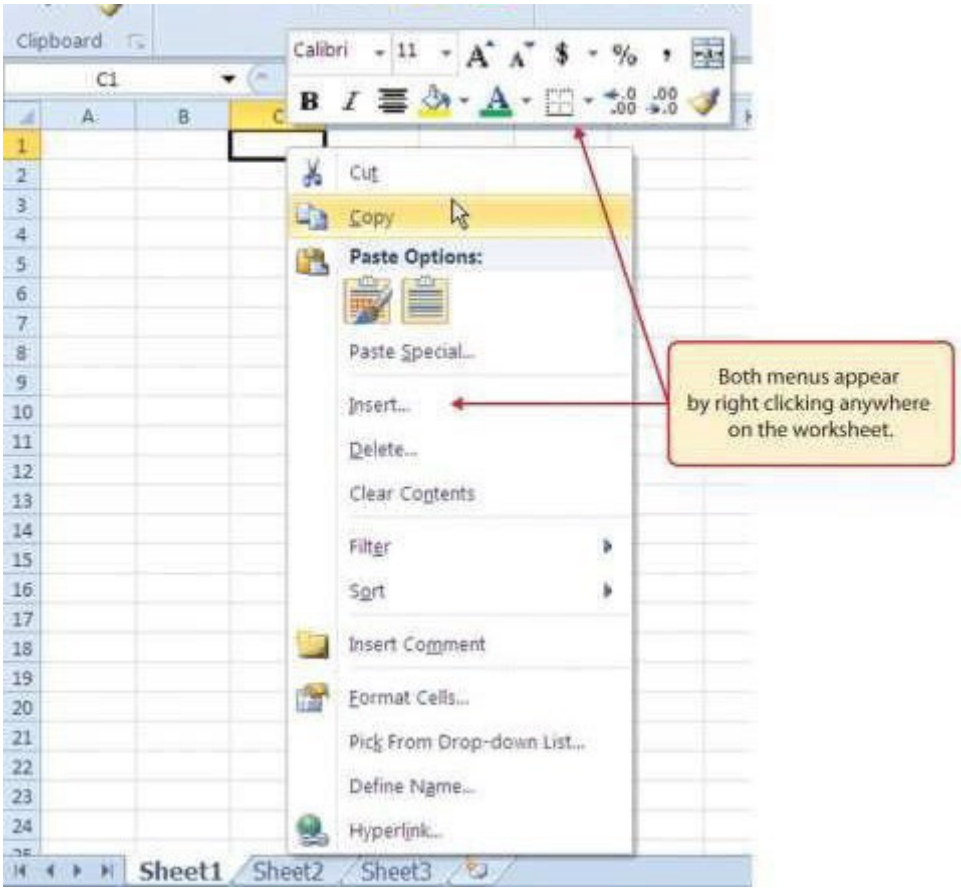
Figure 1.8 Customizing the Quick Access Toolbar



In addition to the Ribbon and Quick Access Toolbar, you can also access commands by right clicking anywhere on the worksheet. Figure 1.9 "Right-Click Menu" shows an example of the commands available in the right-click menu.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 1.9 Right-Click Menu



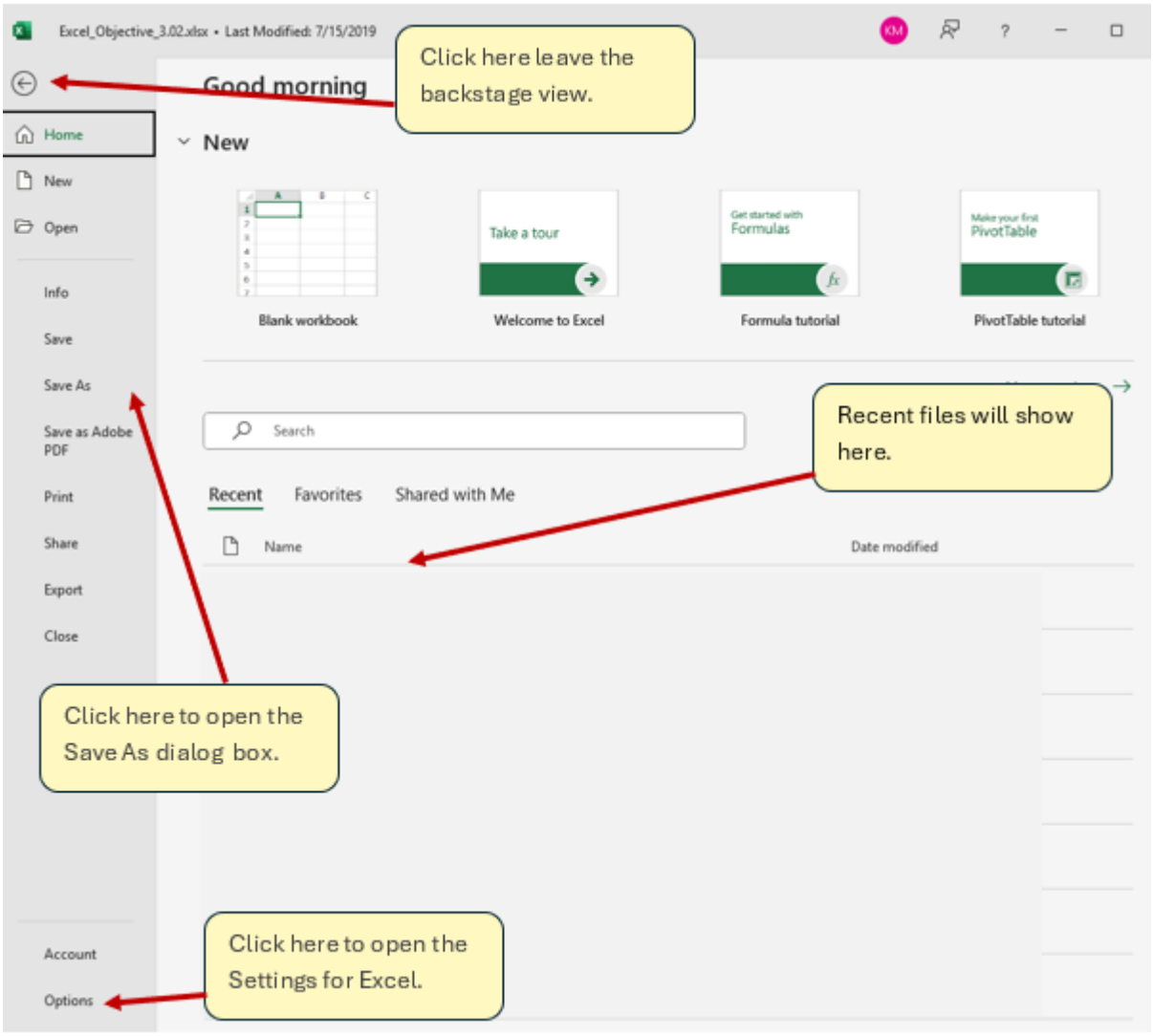
The File Tab

Follow-along file: Not needed for this skill.

The File tab is also known as the Backstage view of the workbook. It contains a variety of features and commands related to the workbook that is currently open, new workbooks, or workbooks stored in other locations on your computer or network. Figure 1.10 "File Tab or Backstage View of a Workbook" shows the options available in the File tab or Backstage view. To leave the Backstage view and return to the worksheet, click on the back arrow in the upper left corner of the file view window.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

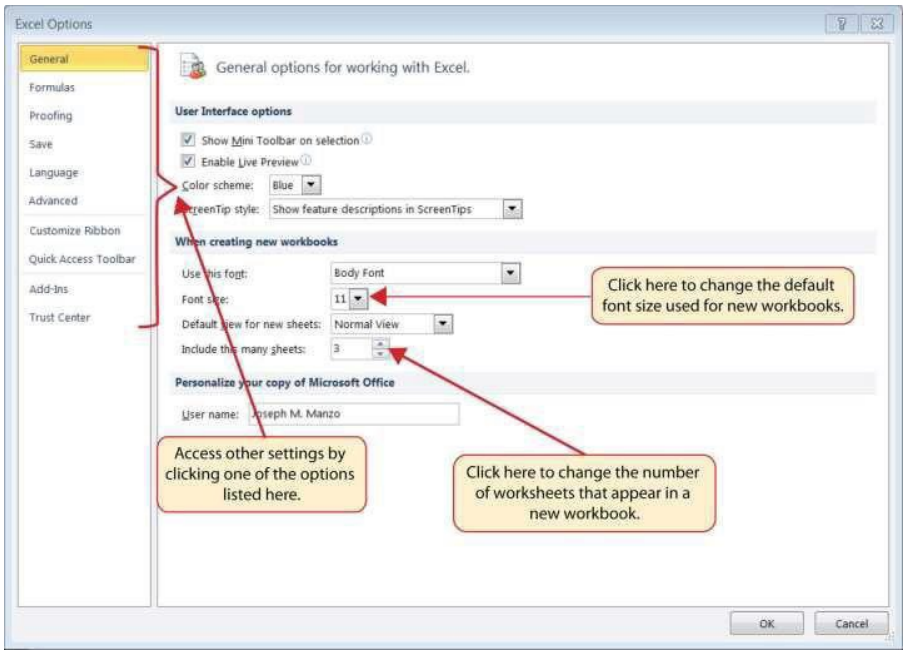
Figure 1.10 File Tab or Backstage View of a Workbook



Included in the File tab are the default settings for the Excel application that can be accessed and modified by clicking the Options button. Figure 1.11 "Excel Options Window" shows the Excel Options window, which gives you access to settings such as the default font style, font size, and the number of worksheets that appear in new workbooks.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 1.11 Excel Options Window



Saving Workbooks (Save As)

Follow-along file: Not needed for this skill.

Once you create a new workbook, you will need to change the file name and choose a location on your computer or network to save it. The following steps explain how to save a new workbook and assign it a file name. It is important to remember where you save this workbook on your computer or network as you will be using this file in the Section 1.2 "Entering, Editing, and Managing Data" to construct the workbook shown in Figure 1.1 "Example of an Excel Worksheet with Embedded Chart".

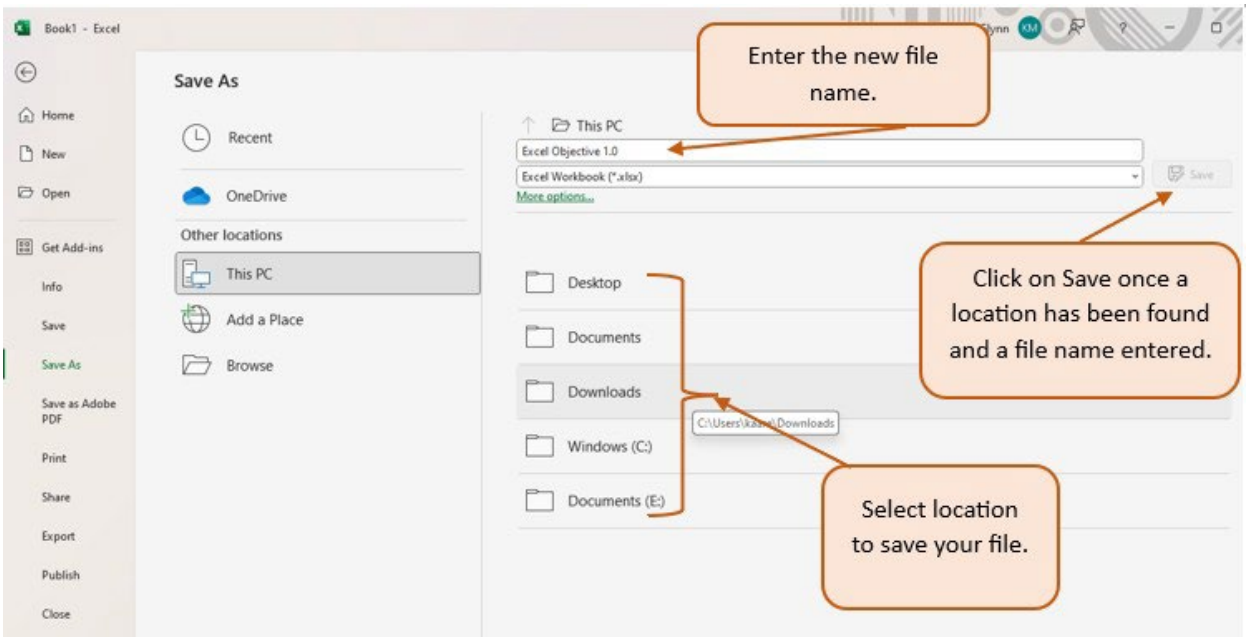
1. If you have not done so already, start Excel. A blank workbook should appear on your screen.
2. Check to make sure the workbook is maximized (see Figure 1.4 "Restored Worksheet").
3. Click the File tab.
4. Click the Save As button in the upper left side of the Backstage view window, as shown in Figure 1.10 "File Tab or Backstage View of a Workbook". This will open the Save As dialog box.
5. Click in the File Name box at the bottom of the Save As dialog box.
6. Use the BACKSPACE key to remove the current file name of the workbook.
7. Type the file name: **Excel Objective 1.0**.
8. Click the Desktop button on the left side of the Save As dialog box if you wish to save this file on your desktop. If you want to save this workbook in a different location on your

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

computer or network, double click the “This PC” option, as shown in Figure 1.12 "Save As Dialog Box” and select your preferred location.

9. Click the Save button on the lower right side of the Save As dialog box.

Figure 1.12 Save As Dialog Box-



Keyboard Shortcuts – Save As
• To quickly access the Save As dialog box, press the F12 key .Use the tab and arrow keys to navigate around the Save As dialog box. Use the ENTER key to make a selection. • Pressing the ALT key on your keyboard will show the shortcut letters and numbers, called Key Tips, appear on the Ribbon. Press the F key on your keyboard for the File tab and then the A key. This will open the Save As dialog box.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Skill Refresher- Saving Workbooks (Save As)

1. Click the File tab on the Ribbon.
2. Click the Save As option.
3. Select a location on your PC or network.
4. Click in the File name box and type a new file name if needed.
5. Click the down arrow next to the "Save as type" box and select the appropriate file type if needed.
6. Click the Save button.

Why?

Workbooks that are created in Office 365 are automatically compatible with Office 2016 and earlier versions. Anyone using Office 365 will be able to open, edit, and save workbooks created in an earlier version.

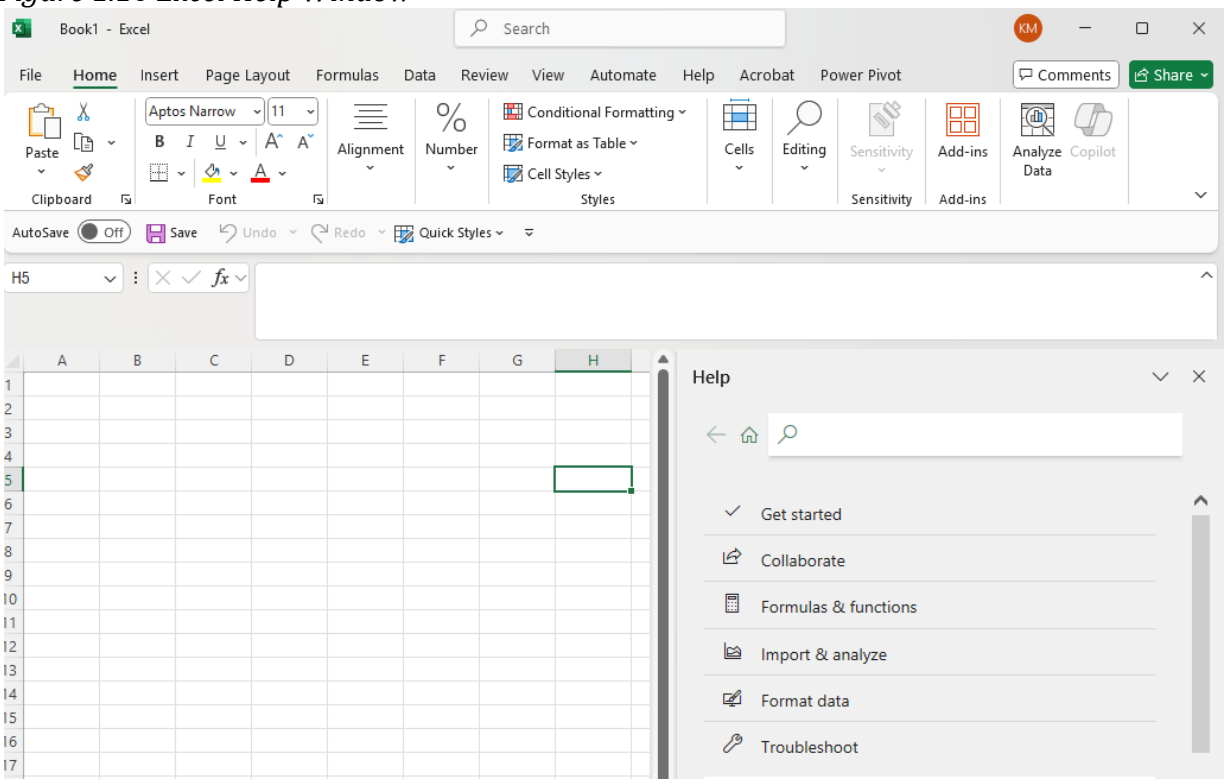
Excel Help

Follow-along file: Continue with a blank workbook or open a new one.

The Help feature provides extensive information about the Excel application. Although some of this information may be stored on your computer, the Help window will automatically connect to the Internet, if you have a live connection, to provide you with resources that can answer most of your questions. You can open the Excel Help window by clicking on the F1 function key, or by clicking on the Help tab on the ribbon. Here you can search for specific topics or type a question in the upper right side of the help dialog box, as shown in Figure 1.16 "Excel Help Window".

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 1.16 Excel Help Window



Keyboard Shortcuts – Excel Help
• Press the F1 key on your keyboard.

Key Takeaways
• Excel is a powerful tool for processing data for the purposes of making decisions • You can find Excel commands throughout the tabs in the Ribbon. • You can customize the Quick Access Toolbar by adding commands you frequently use. • You can add or remove the information that is displayed on the Status Bar • The Help window provides you with extensive information about Excel.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

EXERCISES

1. Which of the following responses best defines the notationA1:B15?
   a. The contents in cell A1 are identical to the contents in cellB15.
   b. The cells between A1 and B15 are hidden.
   c. A cell range or contiguous group of cells that begins with cell A1 and include all cells up to and including cell B15.
   d. A cell link that connects cell A1 to B15.
2. The Spell Check feature is in which tab of the Excel Ribbon?
   a. Home
   b. Review
   c. Data
   d. Formulas
3. Holding down the CTRL key and pressing the F1 key on your keyboard is used to
   a. minimize the Ribbon
   b. open the Excel Help window
   c. save a workbook
   d. switch between open workbooks

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

1.2 Entering, Editing, and Managing Data

LEARNING OBJECTIVES
1. Understand how to enter data into a worksheet.
2. Examine how to edit data in a worksheet.
3. Examine how Auto Fill is used when entering data.
4. Understand how to delete data from a worksheet and use the Undo command.
5. Examine how to adjust column widths and row heights in a worksheet.
6. Understand how to hide columns and rows in a worksheet.
7. Examine how to insert columns and rows into a worksheet.
8. Understand how to delete columns and rows from a worksheet.
9. Learn how to move data to different locations in a worksheet

In this section, we will begin the development of the workbook shown in Figure 1.1 "Example of an Excel Worksheet with Embedded Chart". The skills covered in this section are typically used in the early stages of developing one or more worksheets in a workbook. A theme we will continue to pursue in this book is making your spreadsheets tell a story all by itself. Meaning, a person can look at the spreadsheet and know exactly what information the spreadsheet is conveying.

Entering Data

Follow-along file: Excel Objective 1.0 (This is a blank workbook that was named in the previous section. If you skipped the previous section, open a new workbook, and save it with the file name "Excel Objective 1.0.")

The XYZ Corporation has sales data they would like to have put into a worksheet. They want it professionally formatted and to include an embedded chart. The sales data they are giving you is for the year 2025.

We will begin building the workbook shown in Figure 1.1 "Example of an Excel Worksheet with Embedded Chart" by manually entering data into the worksheet. There are other ways in which you can bring data into an Excel worksheet, such as importing data from a website or a Microsoft Access database. However, we will demonstrate these other methods later.

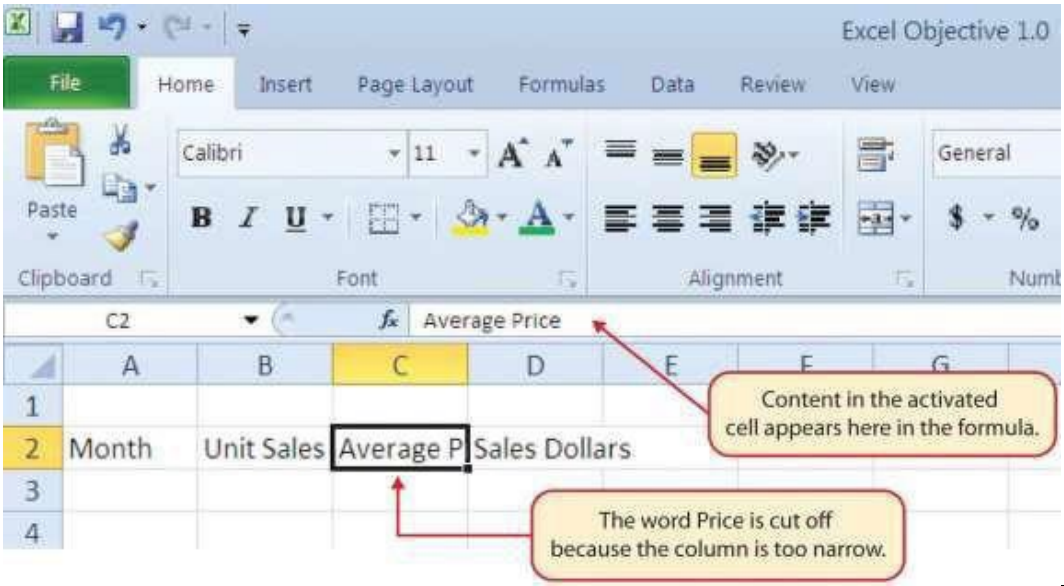
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

The following steps explain how the column headings in Row 2 are typed into the worksheet:

1. Activate cell location A2 on the worksheet.
2. Type the word **Month**. Press the RIGHT ARROW key. This will enter the word into cell A2 and activate the next cell to the right.
3. Type **Unit Sales** and press the RIGHT ARROW key.
4. Repeat step 4 for the words **Average Price** and **SalesDollars**.

Figure 1.17 "Entering Column Headings into a Worksheet" shows how your worksheet should appear after you have typed the column headings into Row 2. Notice that the word *Price* in cell location C2 is not visible. This is because the column is too narrow to fit the entry you typed. We will examine formatting techniques to correct this problem in the next section.

Figure 1.17 Entering Column Headings into a Worksheet



Integrity Check - Column Headings

It is critical to include column headings that accurately describe the data in each column of a worksheet. In professional environments, you will likely be sharing Excel workbooks with coworkers. Good column headings reduce the chance of someone misinterpreting the data contained in a worksheet, which could lead to costly errors depending on your career.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

5. Activate cell location B3. Type the number **2670** and press the ENTER key. After you press the ENTER key, cell B4 will be activated. Using the ENTER key is an efficient way to enter data vertically down a column.
6. Repeat step 5 by entering the following numbers in cells B4 through B14: **2160**, **515**, **590**, **1030**, **2875**, **2700**, **900**, **775**, **1180**, **1800**, and **3560**.
7. Activate cell location C3.
8. Type the number 9.99 and press the ENTER key.
9. Repeat step 8 by entering the following numbers in cells C4 through C14: 12.49, 14.99, 17.49, 14.99, 12.49, 9.99, 19.99, 19.99, 19.99, 17.49, and 14.99.
10. Activate cell location D3.
11. Type the number 26685 and press the ENTER key.
12. Repeat step 12 by entering the following numbers in cells D4 through D14: 26937, 7701, 10269, 15405, 35916, 26937, 17958, 15708, 23562, 31416, and 53370.

Why?

Avoid Formatting Symbols When Entering Numbers

When typing numbers into an Excel worksheet, it is best to avoid adding any formatting symbols such as dollar signs and commas. Although Excel allows you to add these symbols while typing numbers, it slows down the process of entering data. It is more efficient to use Excel's formatting features to add these symbols to numbers after you type them into a worksheet.

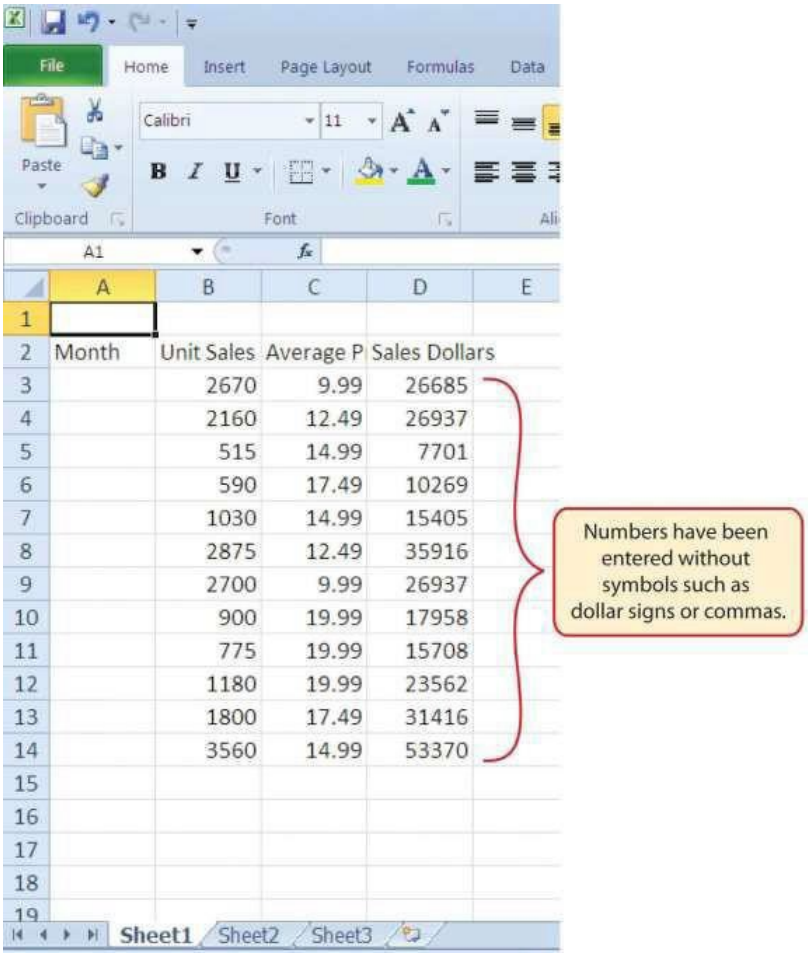
Integrity Check – Data Entry

It is very important to proofread your worksheet carefully, especially when you have entered numbers. Transposing numbers when entering data manually into a worksheet is a common error. For example, the number 563 could be transposed to 536. Such errors can seriously compromise the integrity of your workbook.

Figure 1.18 "Completed Data Entry for Columns B, C, and D" shows how your worksheet should appear after entering the data. Check your numbers carefully to make sure they are accurately entered into the worksheet.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 1.18 Completed Data Entry for Columns B, C, and D



Editing Data

Follow-along file: Excel Objective 1.0 (Use file Excel Objective 1.01 if you are starting with this skill.)

Data that has been entered in a cell can be changed by:

- double clicking the cell location
- clicking in the Formula Bar
- clicking the F2 function key while the cell is active.

You may have noticed that as you were typing data into a cell location, the data you typed appeared in the Formula Bar. The Formula Bar can be used for entering data into cells as well as for editing data that already exists in a cell.

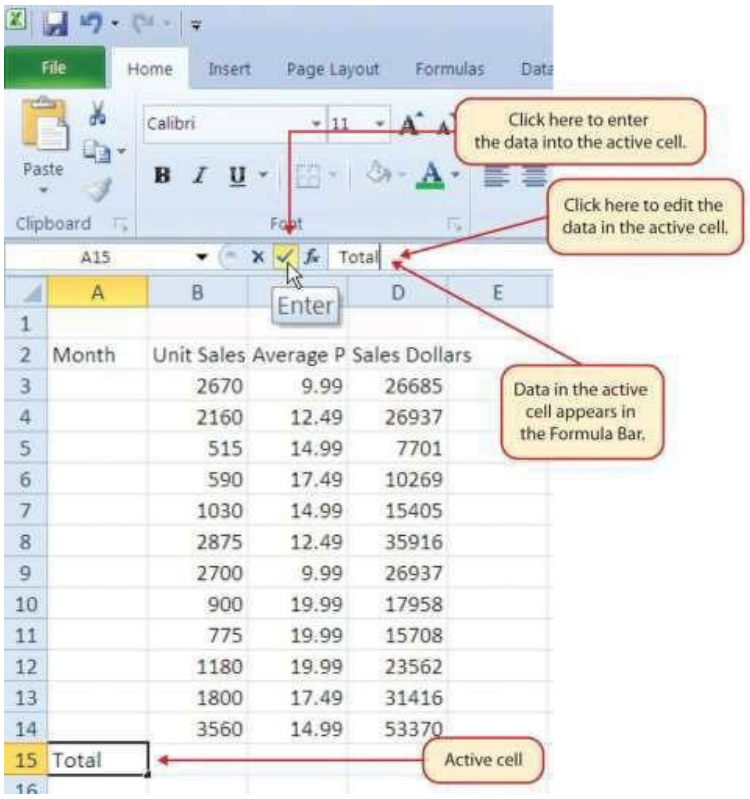
The following steps provide an example of entering and then editing data that has been entered into a cell location:

1. Activate cell A15 in the Sheet1 worksheet.
2. Type the abbreviation Tot and press the ENTER key.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

3. Click cell A15.
4. Move the mouse pointer up to the Formula Bar. You will see the pointer turn into a cursor. Move the cursor to the end of the abbreviation Tot and left click.
5. Type the letters al to complete the word Total.
6. Click the checkmark to the left of the Formula Bar (see Figure 1.19 "Using the Formula Bar to Edit and Enter Data"). This will enter the change into the cell.
7. Double click cell A15.
8. Add a space after the word Total and type the word, Sales.
9. Press the ENTER key.

Figure 1.19 Using the Formula Bar to Edit and Enter Data



Keyboard Shortcuts - Editing Data in a Cell
• Activate the cell that is to be edited and press the F2 key on your keyboard.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

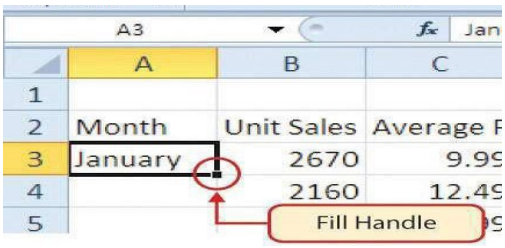
Auto Fill

Follow-along file: Excel Objective 1.0 (Use file Excel Objective 1.02 if you are starting with this skill.)

The Auto Fill feature is a valuable tool when manually entering data into a worksheet. This feature has many uses, but it is most beneficial when you are entering data in a defined sequence, such as the numbers 2, 4, 6, 8, and so on, or nonnumeric data such as the days of the week or months of the year. The following steps demonstrate how Auto Fill can be used to enter the months of the year in Column A:

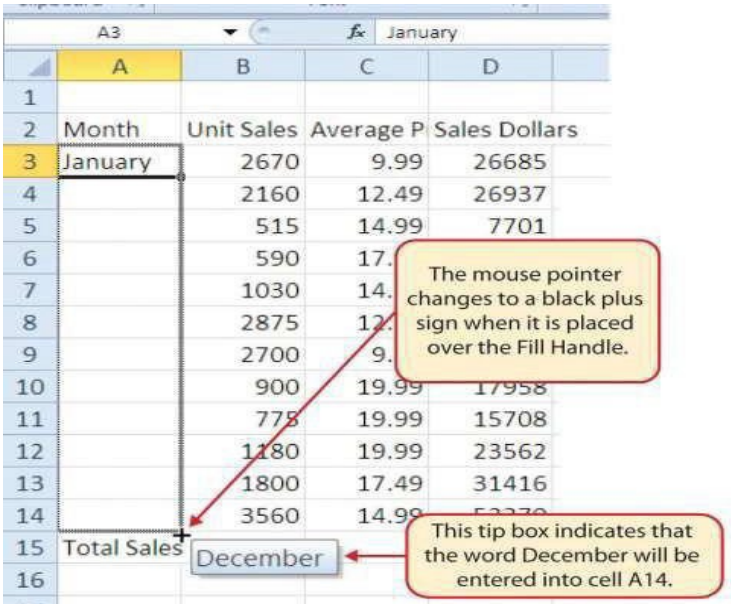
1. Activate cell A3 in the Sheet1worksheet.
2. Type the word **January** and press the Enter key.
3. Activate cell A3 again.
4. Move the mouse pointer to the lower right corner of cell A3. You will see a small square in this corner of the cell; this is called the Fill Handle (see Figure 1.20 "Fill Handle"). When the mouse pointer gets close to the Fill Handle, the white block plus sign will turn into a black plus sign.
5. Left click and drag the Fill Handle to cell A14. Notice that the Auto Fill tip box indicates what month will be placed into each cell (see Figure 1.21 "Using Auto Fill to Enter the Months of the Year"). Release the left mouse button when the tip box reads "December."

Figure 1.20 Fill Handle



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 1.21 Using Auto Fill to Enter the Months of the Year

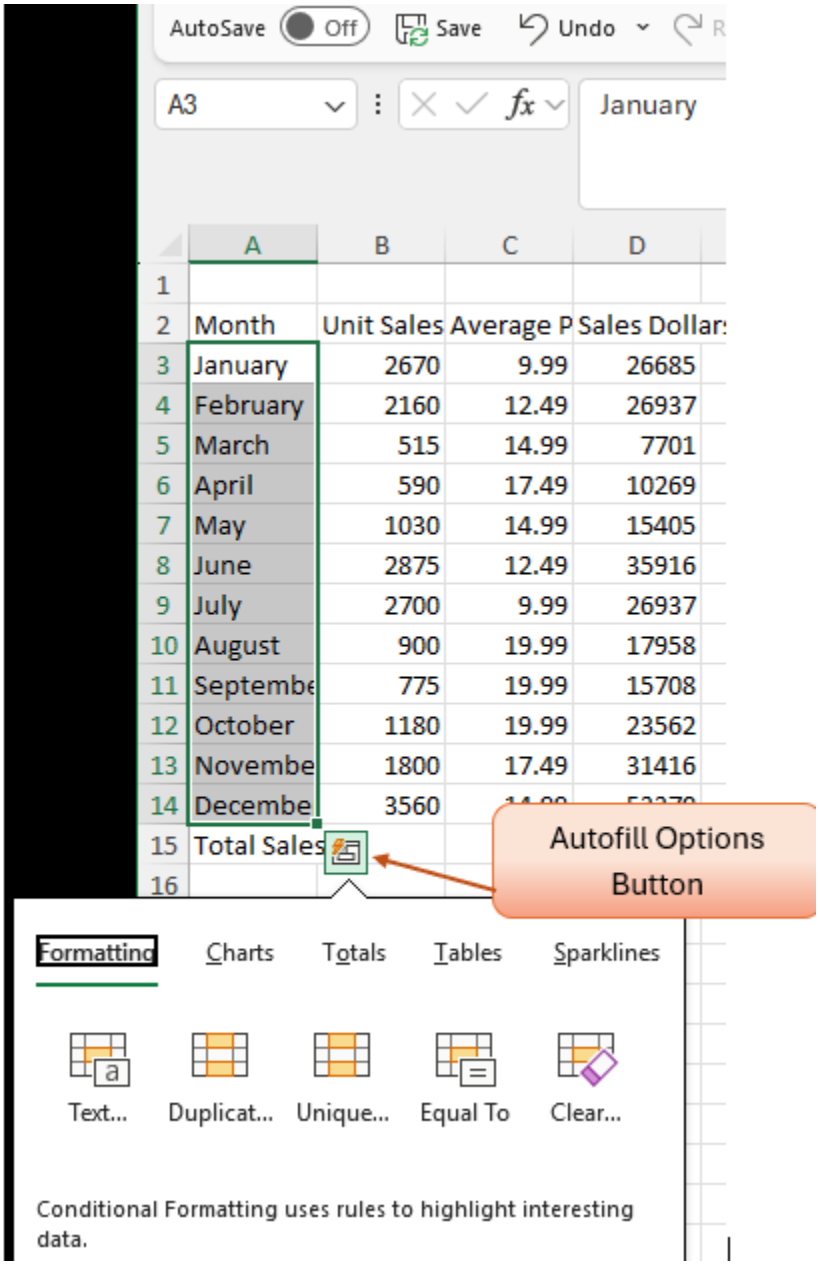


Once you release the left mouse button, all twelve months of the year should appear in the cell range A3:A14, as shown in Figure 1.22 "Auto Fill Options Button". You will also see the Auto Fill Options button. By clicking this button, you have several options for inserting data into a group of cells.

6. Left click the Auto Fill Options button.
7. Left click the Copy Cells option. This will change the months in the range A4:A14 to January.
8. Left click the Auto Fill Options button again.
9. Left click the Fill Months option to return the months of the year to the cell range A4:A14. The Fill Series option will provide the same result.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 1.22 Auto Fill Options Button



Deleting Data and the Undo Command

Follow-along file: Excel Objective 1.0 (Use file Excel Objective 1.03 if you are starting with this skill.)

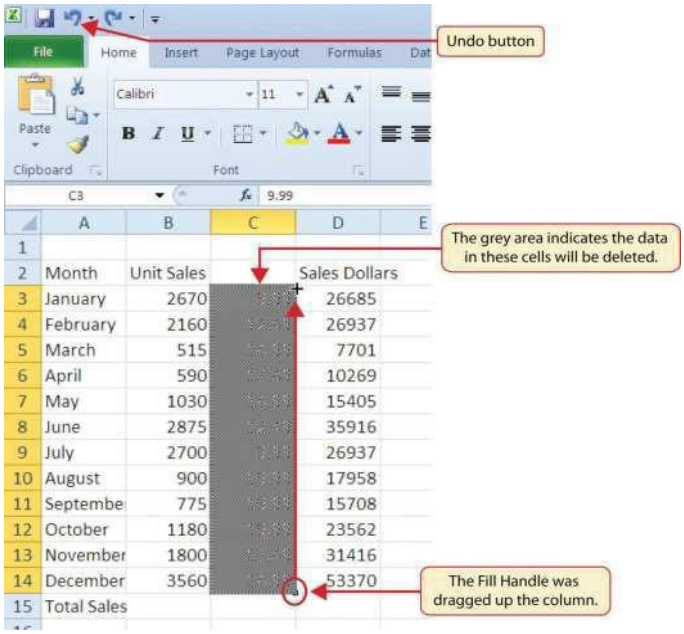
There are several methods for removing data from a worksheet, a few of which are demonstrated here. With each method, you use the Undo command. This is a helpful command in the event you mistakenly remove data from your worksheet.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

The following steps demonstrate how you can delete data from a cell or range of cells:

1. Activate cell C2 by placing the mouse pointer over the cell and clicking the left mouse button.
2. Press the DELETE key on your keyboard. This removes the contents of the cell.
3. Highlight the range C3:C14 by placing the mouse pointer over cell C3. Then left click and drag the mouse pointer down to cell C14.
4. Place the mouse pointer over the Fill Handle. You will see the white block plus sign change to a black plus sign.
5. Left click and drag the mouse pointer up to cell C3 (see Figure 1.23 "Using Auto Fill to Delete Contents of Cell"). Release the mouse button. The contents in the range C3:C14 will be removed.

Figure 1.23 Using Auto Fill to Delete Contents of Cell

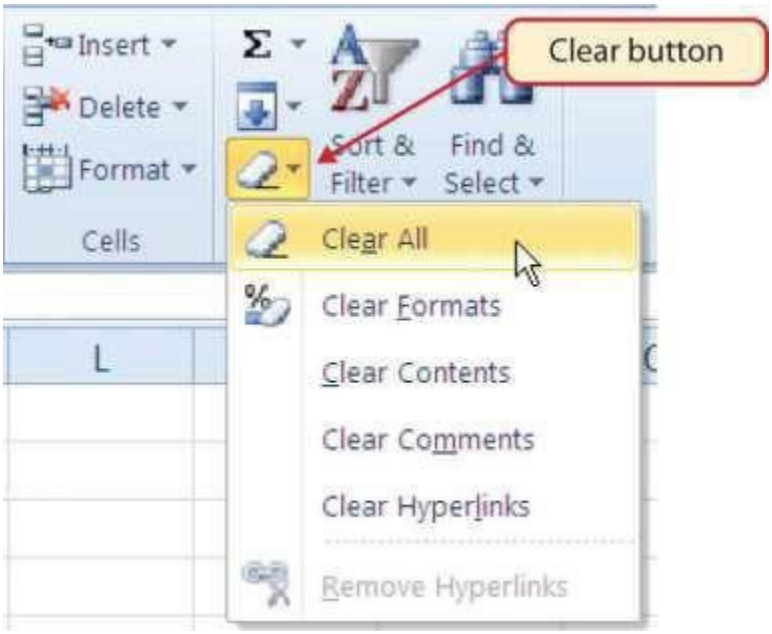


6. Click the Undo button in the Quick Access Toolbar. This should replace the data in the range C3:C14.
7. Click the Undo button again. This should replace the data in cell C2.
8. Highlight the range C2:C14 by placing the mouse pointer over cell C2. Then left click and drag the mouse pointer down to cell C14.
9. Click the Clear button in the Home tab of the Ribbon, which is next to the Cells group of commands (see Figure 1.24 "Clear Command Drop-Down Menu"). This opens a drop-down menu that contains several options for removing or clearing data from a cell. Notice that you also have options for clearing just the formats in a cell or the hyperlinks in a cell.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

10. Click the Clear All option. This removes the data in the cell range.
11. Click the Undo button. This replaces the data in the range C2:C14.

Figure 1.24 Clear Command Drop-Down Menu



Keyboard Shortcuts -Undo Command
• Hold down the CTRL key while pressing the letter *Z* on your keyboard.

Adjusting Columns and Rows

Follow-along file: Excel Objective 1.0 (Use file Excel Objective 1.03 if you are starting with this skill.)

In Figure 1.22 "Auto Fill Options Button", there are a few entries that appear cut off. For example, the last letter of the word *September* cannot be seen in cell A11. This is because the column is too narrow for this word. The columns and rows on an Excel worksheet can be adjusted to accommodate the data that is being entered into a cell. The following steps explain how to adjust the column widths and row heights in a worksheet:

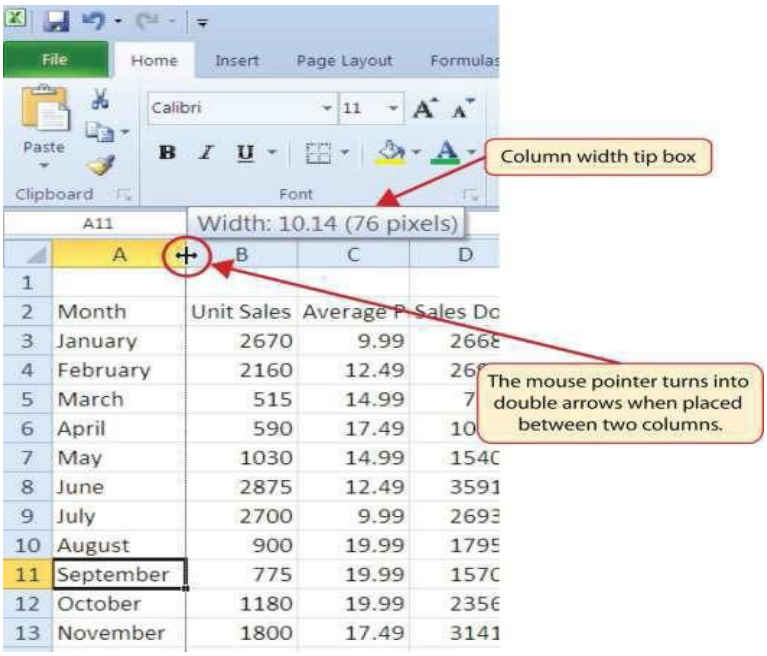
1. Bring the mouse pointer between Column A and Column B in the Sheet1 worksheet, as shown in Figure 1.25 "Adjusting Column Widths". You will see the white block plus sign turn into double arrows.
2. Left click and drag the column to the right so the entire word *September* in cell A11 can be seen. As you drag the column, you will see the column width tip box. This box

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

displays the number of characters that will fit into the column using the Calibri 11-point font.

3. Release the left mouse button.

Figure 1.25 Adjusting Column Widths



You may find that using the click-and-drag method is inefficient if you need to set a specific character width for one or more columns. Steps 4 through 7 illustrate a second method for adjusting column widths when using a specific number of characters:

4. Activate any cell location in Column A by moving the mouse pointer over a cell location and clicking the left mouse button. You can highlight cell locations in multiple columns if you are setting the same character width for more than one column.

5. In the Home tab of the Ribbon, left click the Format button in the Cells group (seeFigure 1.26 "Cells Group in the Home Tab").

6. Click the Column Width option from the drop-down menu (see Figure 1.27 "Format Drop-Down Menu"). This will open the Column Width dialog box.

7. Type the number **13** and click the OK button on the Column Width dialog box. This will set Column A to this character width (see Figure 1.28 "Column Width Dialog box").

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 1.26 Cells Group in the Home Tab

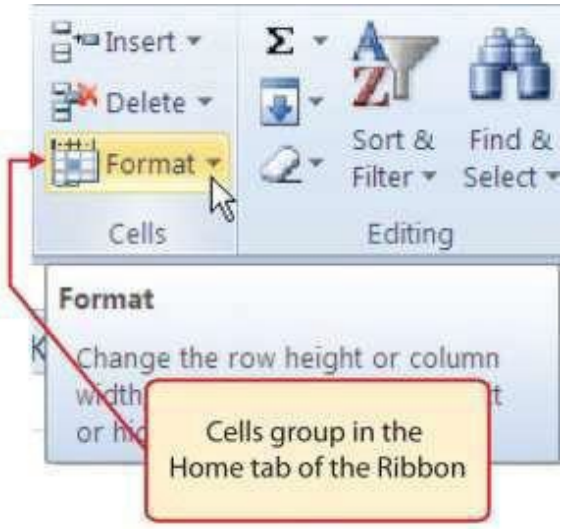
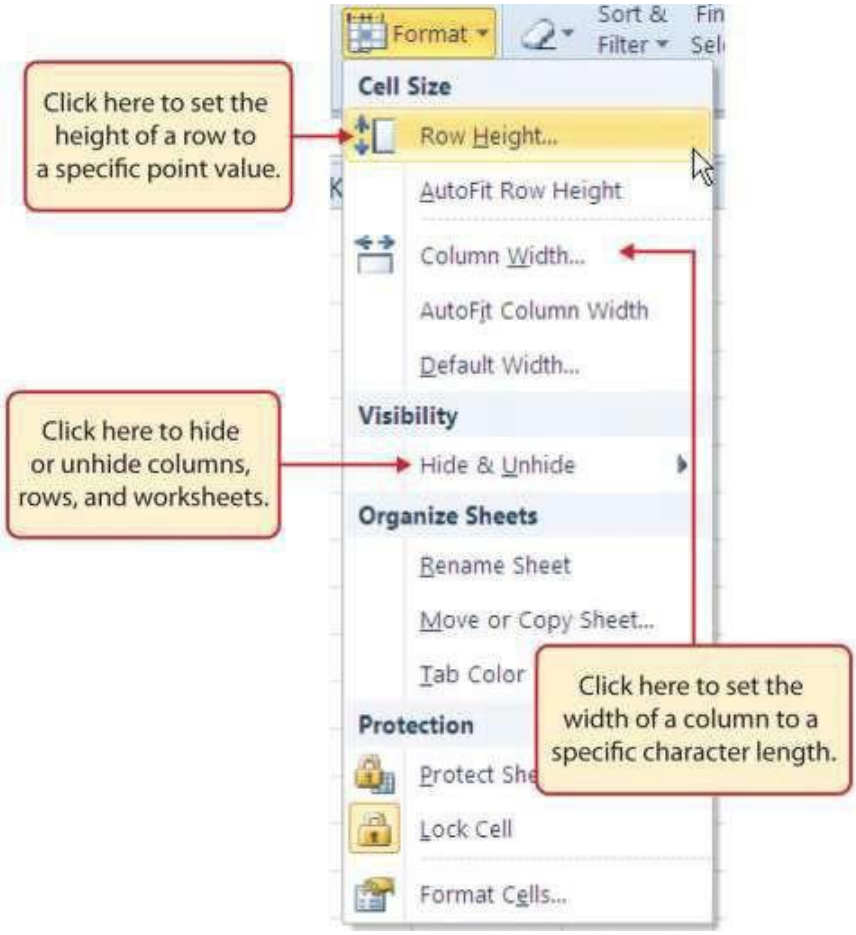
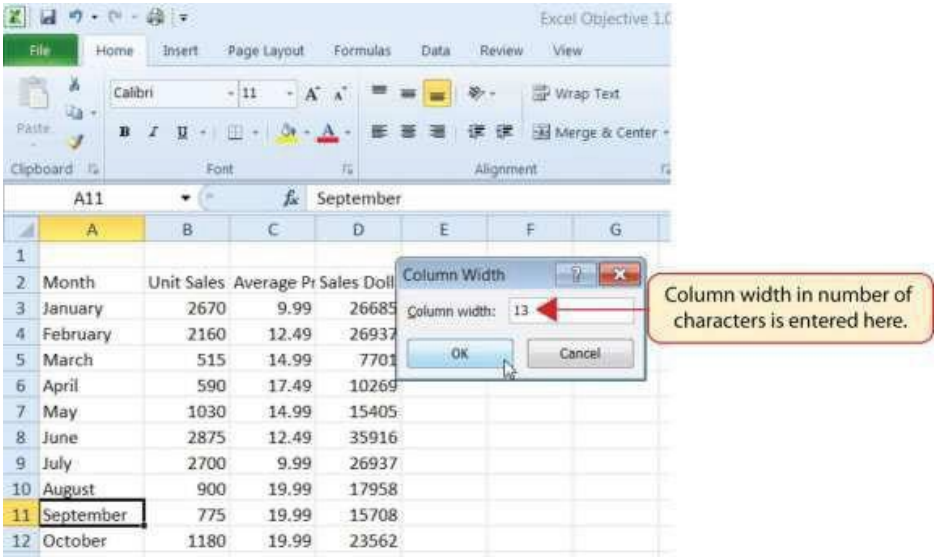


Figure 1.27 Format Drop-Down Menu



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 1.28 Column Width Dialog Box



Month	Unit Sales	Average Pr	Sales Doll
January	2670	9.99	26685
February	2160	12.49	26937
March	515	14.99	7701
April	590	17.49	10269
May	1030	14.99	15405
June	2875	12.49	35916
July	2700	9.99	26937
August	900	19.99	17958
September	775	19.99	15708
October	1180	19.99	23562

Keyboard Shortcuts - Column Width
• Press and hold the ALT key on your keyboard while pressing the letters *H*, *O*, and *W* one at a time.

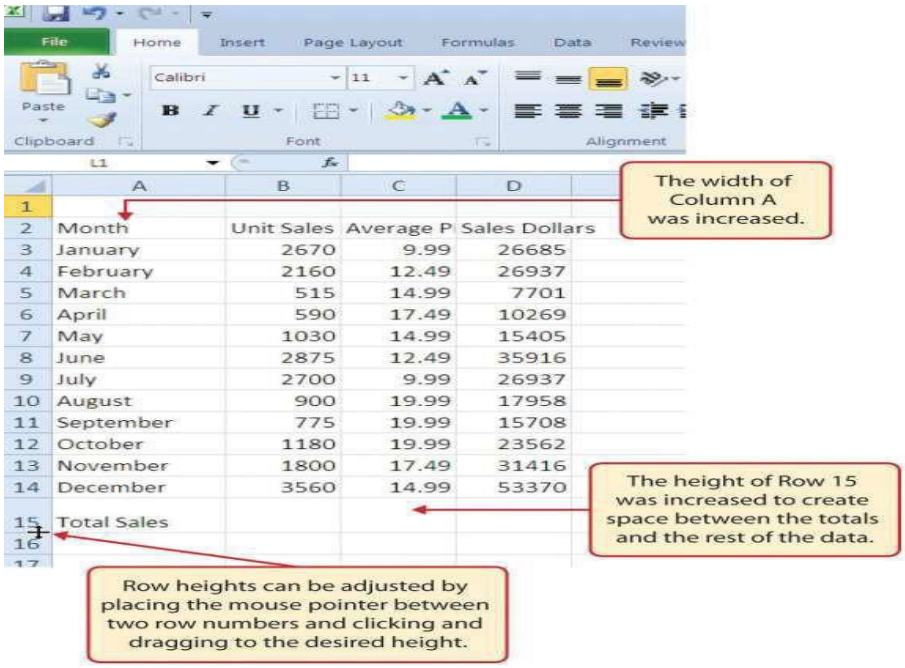
The following steps demonstrate how to adjust row height, which is like adjusting column width:

1. Activate cell A15 by placing the mouse pointer over the cell and clicking the left mouse button.
2. In the Home tab of the Ribbon, left click the Format button in the Cells group (see Figure 1.26 "Cells Group in the Home Tab").
3. Click the Row Height option from the drop-down menu (see Figure 1.27 "Format Drop-Down Menu"). This will open the Row Height dialog box.
4. Type the number **24** and click the OK button on the Row Height dialog box. This will set Row 15 to a height of 24 points. A point is equivalent to approximately 1/72 of an inch. This adjustment in row height was made to create space between the totals for this worksheet and the rest of the data.

Figure 1.29 "Excel Objective 1.0 with Column A and Row 15 Adjusted" shows the appearance of the worksheet after Column A and Row 15 are adjusted.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 1.29 Excel Objective 1.0 with Column A and Row 15 Adjusted



Keyboard Shortcuts – Row Height
• Press the ALT key on your keyboard, then press the letters *H*, *O*, and *H*ome at a time.

Skill Refresher – Adjusting Columns and Rows
1. Activate at least one cell in the row or column you are adjusting. 2. Click the Home tab of the Ribbon. 3. Click the Format button in the Cells group. 4. Click either Row Height or Column Width from the drop-down menu. 5. Enter the Row Height in points or Column Width in characters in the dialogbox. 6. Click the OK button.

Hiding Columns and Rows

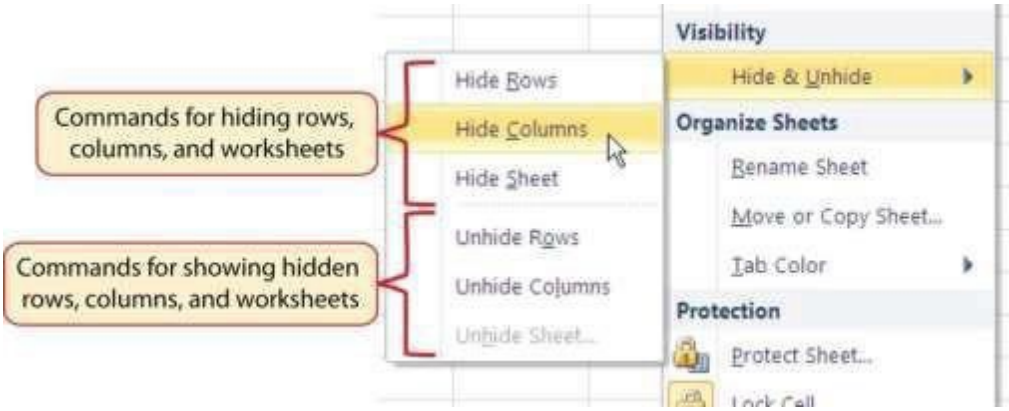
Follow-along file: Excel Objective 1.0 (Use file Excel Objective 1.04 if you are starting with this skill.)

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

In addition to adjusting the columns and rows on a worksheet, you can also hide columns and rows. This is a useful technique for enhancing the visual appearance of a worksheet that contains data that is not necessary to display. These features will be demonstrated using the Excel Objective 1.0 workbook. However, there is no need to have hidden columns or rows for this worksheet. The use of these skills here will be for demonstration purposes only.

1. Activate cell C1 in the Sheet1 worksheet by placing the mouse pointer over the cell location and clicking the left mouse button.
2. Click the Format button in the Home tab of the Ribbon.
3. Place the mouse pointer over the Hide & Unhide option in the drop-down menu (see Figure 1.27 "Format Drop-Down Menu"). This will open a submenu of options.
4. Click the Hide Columns option in the submenu of options (see Figure 1.30 "Hide & Unhide Submenu"). This will hide Column C.

Figure 1.30 Hide & Unhide Submenu

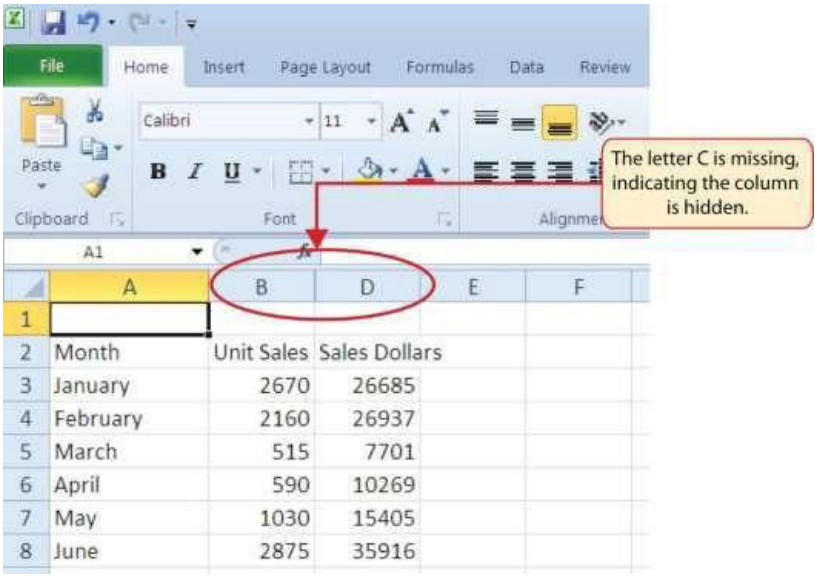


Keyboard Shortcuts – Hiding Columns
• Be in the column you want to hide. Hold down the CTRL key while pressing the number 0 on your keyboard.

Figure 1.31 "Hidden Column" shows the workbook with Column C hidden in the Sheet1 worksheet. You can tell a column is hidden by the missing letter *C*.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 1.31 Hidden Column



To unhide a column, follow these steps:

1. Highlight the range B1:D1 by activating cell B1 and clicking and dragging over to cell D1.
2. Click the Format button in the Home tab of the Ribbon.
3. Place the mouse pointer over the Hide & Unhide option in the drop-down menu (see Figure 1.27 "Format Drop-Down Menu").
4. Click the Unhide Columns option in the submenu of options (see Figure 1.30 "Hide & Unhide Submenu"). Column C will now be visible on the worksheet.

The following steps demonstrate how to hide rows, which is like hiding columns:

1. Activate cell A3 in the Sheet1 worksheet by placing the mouse pointer over the cell location and clicking the left mouse button.
2. Click the Format button in the Home tab of the Ribbon.
3. Place the mouse pointer over the Hide & Unhide option in the drop-down menu (see Figure 1.27 "Format Drop-Down Menu"). This will open a submenu of options.
4. Click the Hide Rows option in the submenu of options (see Figure 1.30 "Hide & Unhide Submenu"). This will hide Row 3.

Keyboard Shortcuts – Hiding Rows
• Hold down the CTRL key while pressing the number 9 key on your keyboard.

To unhide a row, follow these steps:

1. Highlight the range A2:A4 by activating cell A2 and clicking and dragging over to cell A4.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

2. Click the Format button in the Home tab of the Ribbon.
3. Place the mouse pointer over the Hide & Unhide option in the drop-down menu (see Figure 1.27 "Format Drop-Down Menu").
4. Click the Unhide Rows option in the submenu of options (see Figure 1.30 "Hide & Unhide Submenu"). Row 3 will now be visible on the worksheet.

Skill Refresher – Hiding Columns and Rows

1. Activate at least one cell in the row(s) or column(s) you are hiding.
2. Click the Home tab of the Ribbon.
3. Click the Format button in the Cells group.
4. Place the mouse pointer over the Hide & Unhide option.
5. Click either the Hide Rows or Hide Columns option.

Inserting Columns and Rows

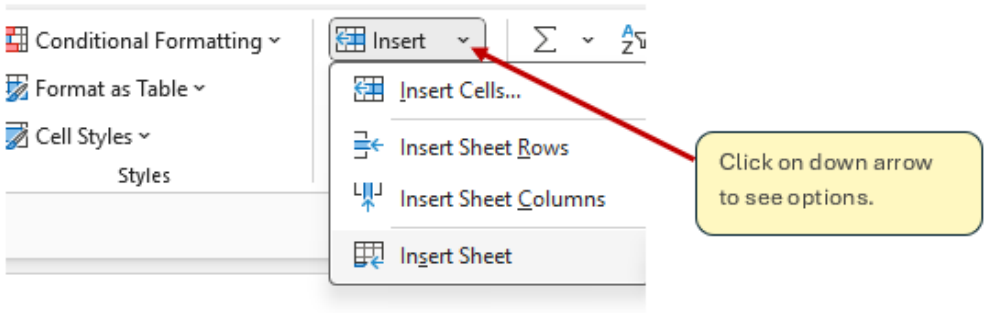
Follow-along file: Excel Objective 1.0 (Use file Excel Objective 1.04 if you are starting with this skill.)

Using Excel workbooks that have been created by others is a very efficient way to work because it eliminates the need to create data worksheets from scratch. However, you may find that to accomplish your goals, you need to add additional columns or rows of data. In this case, you can insert blank columns or rows into a worksheet. The following steps demonstrate how to do this:

1. Activate cell C1 in the Sheet1 worksheet by placing the mouse pointer over the cell location and clicking the left mouse button.
2. Click the down arrow on the Insert button in the Home tab of the Ribbon (see Figure 1.32 "Insert Button (Down Arrow)").
3. Click the Insert Sheet Columns option from the drop-down menu (see Figure 1.33 "Insert Drop- Down Menu"). A blank column will be inserted to the left of Column C. The contents that were previously in Column C now appear in Column D. Note that columns are always inserted to the left of the activated cell.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 1.32 Insert Button (Down Arrow)



Keyboard Shortcuts – Inserting Columns
• Press the ALT key and then the letters *H*, *I*, and *C* one at a time. A column will be inserted to the left of the activated cell.

4. Activate cell A3 in the Sheet1 worksheet by placing the mouse pointer over the cell location and clicking the left mouse button.
5. Click the down arrow on the Insert button in the Home tab of the Ribbon (see Figure 1.32 "Insert Button (Down Arrow)").
6. Click the Insert Sheet Rows option from the drop-down menu (see Figure 1.33 "Insert Drop-Down Menu"). A blank row will be inserted above Row 3. The contents that were previously in Row 3 now appear in Row 4. Note that rows are always inserted above the activated cell.

Keyboard Shortcuts – Inserting Rows
• Press the ALT key and then the letters *H*, *I*, and *R* one at a time. A row will be inserted above the activated cell.

Skill Refresher – Inserting Columns and Rows
1. Activate the cell to the right of the desired blank column or below the desired blank row. 2. Click the Home tab of the Ribbon. 3. Click the down arrow on the Insert button in the Cells group. 4. Click either the Insert Sheet Columns or Insert Sheet Rows option

Moving Data

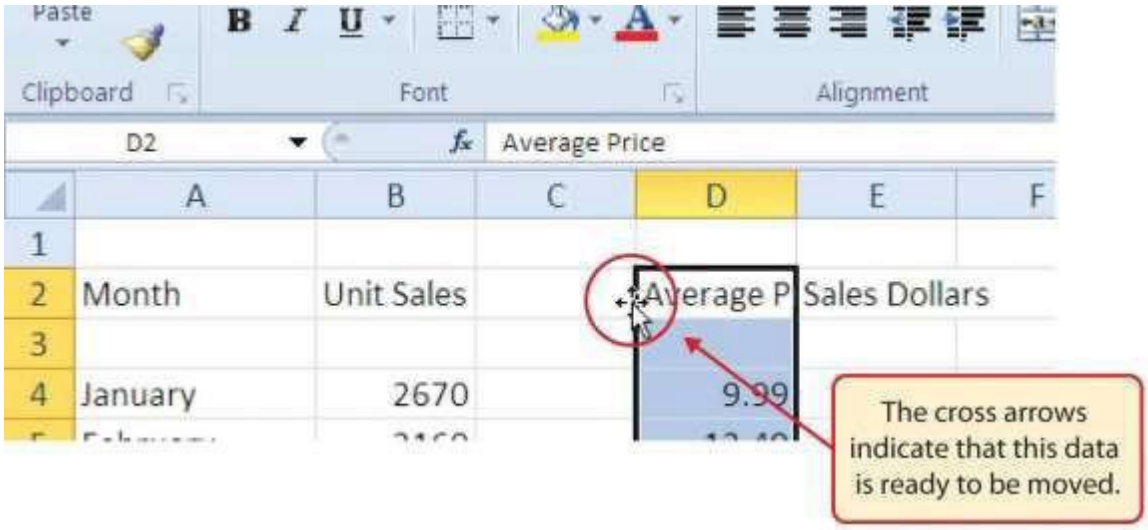
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Follow-along file: Excel Objective 1.0 (Use file Excel Objective 1.05 if you skipped the previous skill and are starting with this skill.)

Once data is entered into a worksheet, you can move it to different locations. The following steps demonstrate how to move data to different locations on a worksheet:

1. Highlight the range D2:D15 by activating cell D2 and clicking and dragging down to cell D15.
2. Bring the mouse pointer to the left edge of cell D2. You will see the white block plus sign change to cross arrows (see Figure 1.34 "Moving Data"). This indicates that you can left click and drag the data to a newlocation.
3. Left click and drag the mouse pointer to cellC2.
4. Release the left mouse button. The data now appears in Column C.
5. Click the Undo button in the Quick Access Toolbar. This moves the data back to Column D.

Figure 1.34 Moving Data



Integrity Check – Moving Data
Before moving data on a worksheet, make sure you identify all the components that belong with the series you are moving. For example, if you are moving a column of data, make sure the column heading is included. Also, make sure all values are highlighted in the column before moving it.

Deleting Columns and Rows

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

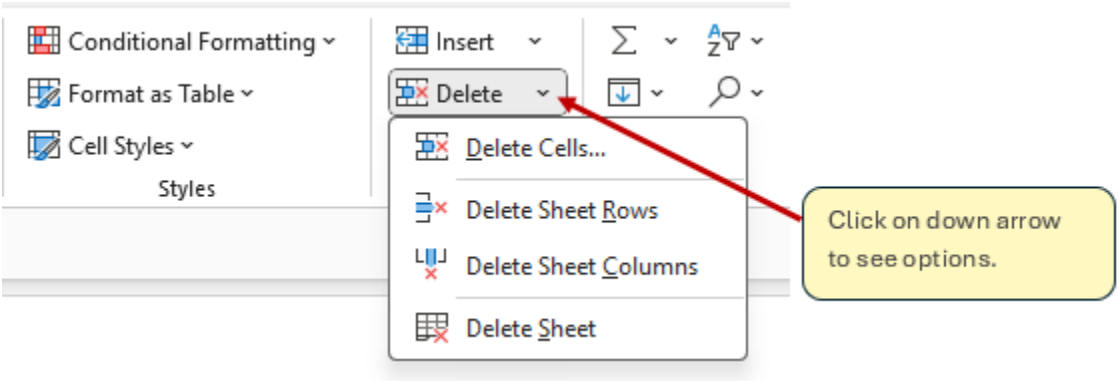
Follow-along file: Excel Objective 1.0 (Use file Excel Objective 1.05 if you are starting with this skill.)

You may need to delete entire columns or rows of data from a worksheet. This need may arise if you need to remove either blank columns or rows from a worksheet or columns and rows that contain data. The methods for removing cell contents were covered earlier and can be used to delete unwanted data.

However, if you do not want a blank row or column in your workbook, you can delete it using the following steps:

1. Activate cell A3 by placing the mouse pointer over the cell location and clicking the left mouse button.
2. Click the down arrow on the Delete button in the Cells group in the Home tab of the Ribbon.
3. Click the Delete Sheet Rows option from the drop-down menu (see Figure 1.35 "Delete Drop- Down Menu"). This removes Row 3 and shifts all the data (below Row 2) in the worksheet up one row.

Figure 1.35 Delete Drop-Down Menu



4. Activate cell C1 by placing the mouse pointer over the cell location and clicking the left mouse button.
5. Click the down arrow on the Delete button in the Cells group in the Home tab of the Ribbon.
6. Click the Delete Sheet Columns option from the drop-down menu (see Figure 1.35 "Delete Drop- Down Menu"). This removes Column C and shifts all the data in the worksheet (to the right of Column B) over one column to the left.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Keyboard Shortcuts – Deleting Columns

- Select a cell in the column Press the ALT key and then the letters *H*, *D*, and *C* one at a time. The column with the activated cell will be deleted.

Skill Refresher – Deleting Columns and Rows

1. Activate any cell in the row or column that is to be deleted.
2. Click the Home tab of the Ribbon.
3. Click the down arrow on the Delete button in the Cells group.
4. Click either the Delete Sheet Columns or the Delete Sheet Rows option

Key Takeaways

- Column headings should be used in a worksheet and should accurately describe the data contained in each column.
- Using symbols such as dollar signs when entering numbers into a worksheet can slow down the data entry process.
- Worksheets must be carefully proofread when data has been manually entered.
- The Undo command is a valuable tool for recovering data that was deleted from a worksheet.
- When using a worksheet that was developed by someone else, look carefully for hidden column or rows

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

EXERCISES

1. When entering numeric data into an Excel worksheet, you should omit symbols such as commas or dollar signs because:
   a. These numbers will not be usable in mathematical functions or formulas.
   b. Excel will convert this to text data.
   c. Excel will not accept these entries into a cell location.
   d. It slows down the data entry process.
2. Which of the following statements is true with respect to editing the content in a cell location?
   a. Activate the cell location and press the F2 key on your keyboard to edit the data in the cell.
   b. Double click the cell location to edit the data in a cell location.
   c. Activate the cell location, click the Formula Bar, and make any edits for the cell location in the Formula Bar.
   d. All the above are true.
3. Which of the following will enable you to identify hidden columns in a worksheet?
   a. The column letter appears in a tip box when the mouse pointer is moved over a hidden column.
   b. Clicking the Page Layout View button in the View tab of the Ribbon shows all columns in the worksheet and shades hidden columns.
   c. The column letters that appear above the columns in a worksheet will be missing for hidden columns.
   d. Click the Hidden Columns indicator in the Status Bar.
4. Which of the following is true with respect to inserting blank rows into a worksheet?
   a. Blank rows are inserted above the activated cell or cell range in a worksheet.
   b. Blank rows are always inserted in the center of a cell range. At least two or more cells in a worksheet must be highlighted before a row can be inserted.
   c. The command for inserting blank rows and columns can be found by clicking the Format button in the Home tab of the Ribbon.
   d. When inserting blank rows into a worksheet, the Undo button is disabled. You must use the Delete button in the Home tab of the Ribbon to remove unwanted blank rows.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

1.3 Formatting and Data Analysis

LEARNING OBJECTIVES
1. Use formatting techniques to enhance the appearance of a worksheet.
2. Understand how to align data in cell locations.
3. Examine how to enter multiple lines of text in a cell location.
4. Understand how to add borders to a worksheet.
5. Examine how to use the AutoSum feature to calculate totals.
6. Understand how to insert a chart into a worksheet.
7. Use the Cut, Copy, and Paste commands to manipulate the data on a worksheet.
8. Examine how to use the Sort command to rank data on a worksheet.
9. Understand how to move, rename, insert, and delete worksheet tabs.

This section addresses formatting commands that can be used to enhance the visual appearance of a worksheet. It also introduces mathematical calculations and charts. The skills introduced in this section will give you powerful tools for analyzing the data that we have been working with in this workbook and will highlight how Excel is used to make key decisions in virtually any career.

Formatting Data and Cells

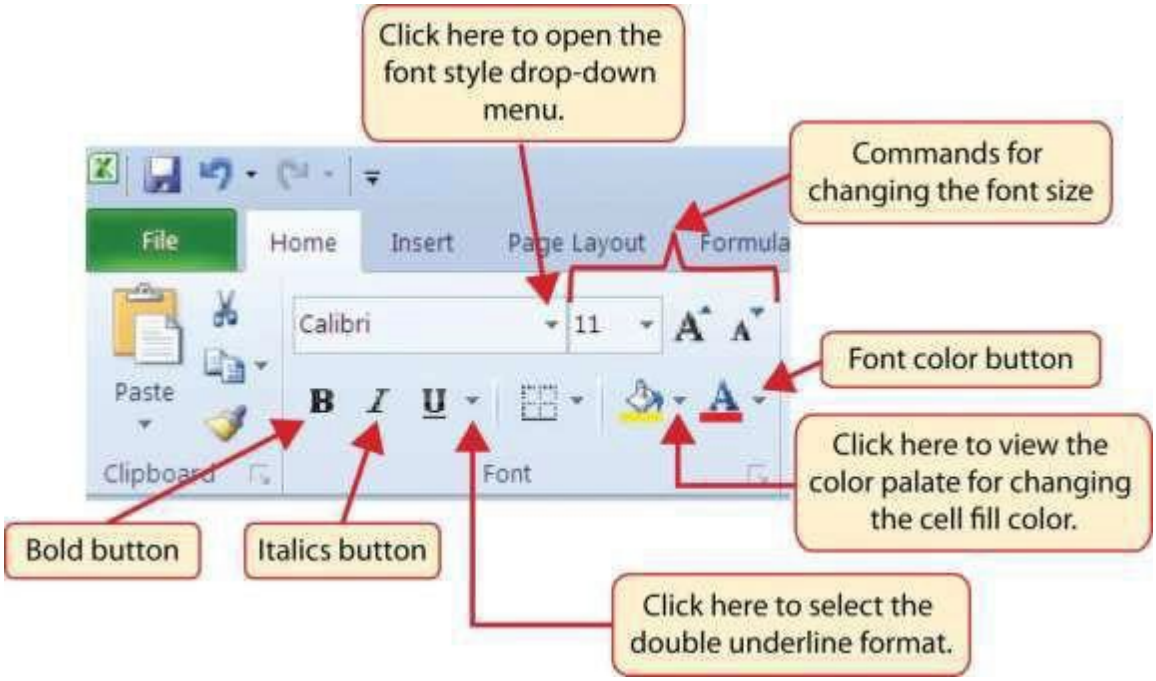
Follow-along file: Excel Objective 1.0 (Use file Excel Objective 1.04 if you are starting with this skill.)

Enhancing the visual appearance of a worksheet is a critical step in creating a valuable tool for you or your coworkers when making key decisions. The following steps demonstrate several fundamental formatting skills that will be applied to the workbook that we are developing for this chapter. Several of these formatting skills are identical to ones that you may have already used in other Microsoft applications such as Microsoft® Word® or Microsoft® PowerPoint®.

1. Highlight the range A2:D2 in the Sheet1 worksheet by placing the mouse pointer over cell A2 and left clicking and dragging to cellD2.
2. Click the Bold button in the Font group of commands in the Home tab of the Ribbon(see Figure 1.36 "Font Group of Commands").

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 1.36 Font Group of Commands



3. Highlight the range B15:D15 by placing the mouse pointer over cell A15 and left clicking and dragging to cell D15.
4. Click the Bold button in the Font group of commands in the Home tab of the Ribbon.
5. Click the Italics button in the Font group of commands in the Home tab of the Ribbon.
6. Highlight the range B15:D15. Click the drop-down arrow next to the Borders button in the Font group of commands in the Home tab of the Ribbon. From the drop-down, select the Top and Double Bottom border style. This is a standard business/accounting presentation of totals in a worksheet and denotes the end of a set of data.

Figure 1.36b Border Icon

7. Highlight the range B3:B14 by placing the mouse pointer over cell B3 and left clicking and dragging down to cell B14.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

8. Click the Comma Style button in the Number group of commands in the Home tab of the Ribbon (see Figure 1.37 "Number Group of Commands").

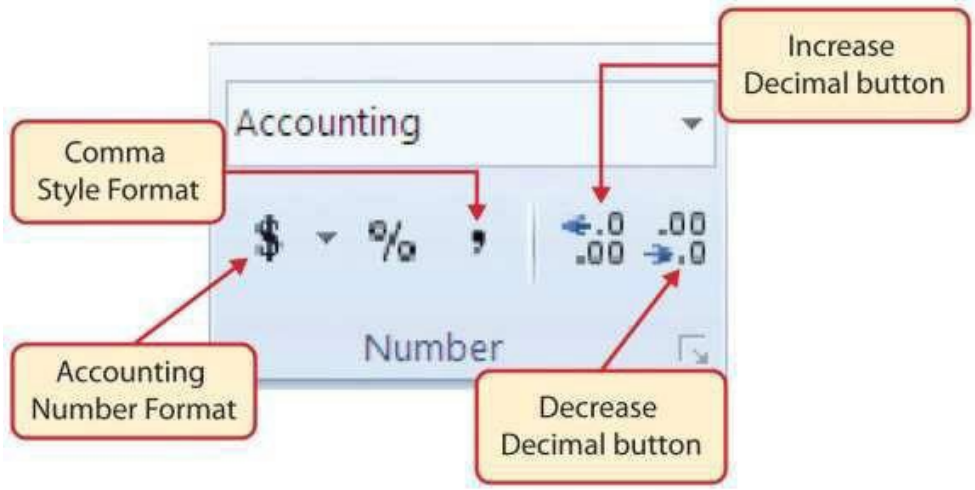


Figure 1.37 Number Group of Commands

9. Click the Decrease Decimal button in the Number group of commands in the Home tab of the Ribbon (see Figure 1.37 "Number Group of Commands").
10. The numbers will also be reduced to zero decimal places.
11. Highlight the range C3:D3 by placing the mouse pointer over cell C3 and left clicking and dragging across to cell D3.
12. Click the Accounting Number Format button in the Number group of commands in the Home tab of the Ribbon (see Figure 1.37 "Number Group of Commands"). This will add the US currency symbol and two decimal places to the values. This format is common when working with pricing data.

Keyboard Shortcuts
Bold Format • Hold the CTRL key while pressing the letter *B* on your keyboard. **Italics Format** • Hold the CTRL key while pressing the letter I on your keyboard. **Underline Format** • Hold the CTRL key while pressing the letter U on your keyboard.

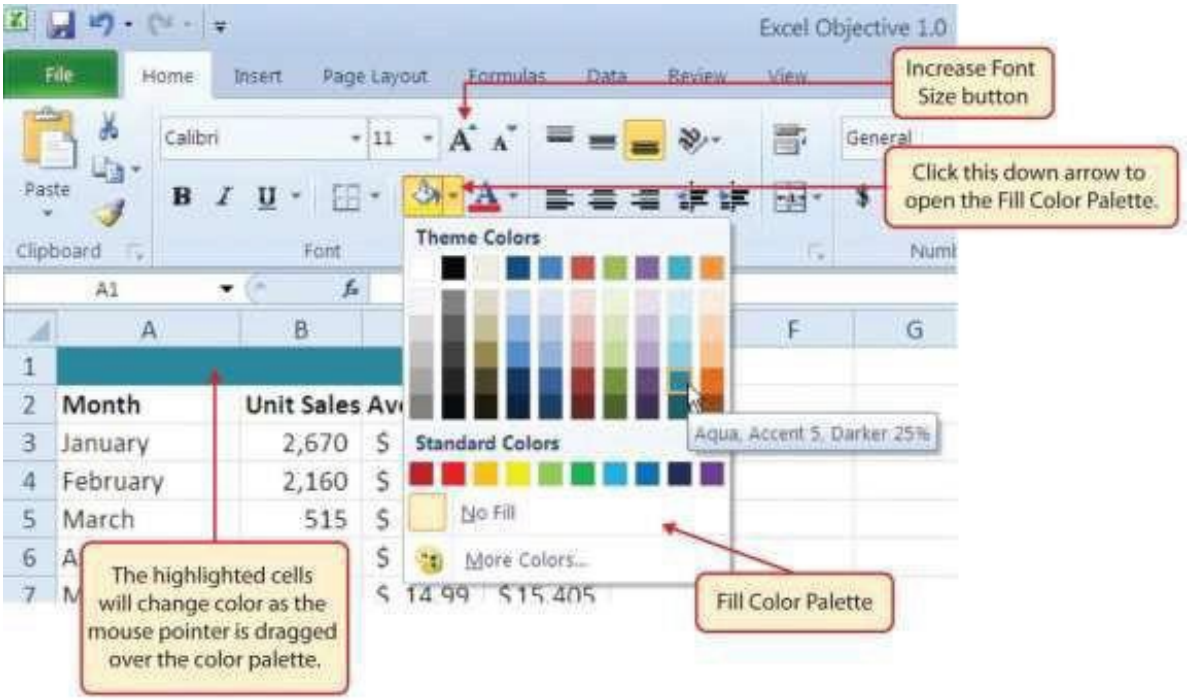
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Why?
Format Column Headings and Totals Applying formatting enhancements to the column headings and column totals in a worksheet is a very important technique, especially if you are sharing a workbook with other people. These formatting techniques allow users of the worksheet to clearly see the column headings that define the data. In addition, the column totals usually contain the most important data on a worksheet with respect to making decisions, and formatting techniques allow users to quickly see this information

13. Highlight the range C4:D14 by placing the mouse pointer over cell D3 and left clicking and dragging down to cell D14.
14. Click the Comma symbol to the values as well as two decimal places. Comma style aligns numbers with the Accounting $ style in the cell.
15. Highlight D3:D14 and click the Decrease Decimal button twice in the Number group of commands in the Home tab of the Ribbon. You are decreasing the decimals to none because the Sales Dollars do not need any cents displayed. Decimal places when only zeroes are displayed will add clutter to your worksheet and make it more difficult to read.
16. This will add the comma style to the values and reduce the decimal places to zero. The comma style aligns the numbers in the cells with the Accounting style where $ are displayed.
17. Highlight the range A1:D1 by placing the mouse pointer over cell A1 and left clicking and dragging over to cell D1.
18. Click the down arrow next to the Fill Color button in the Font group of commands in the Home tab of the Ribbon (see Figure 1.38 "Fill Color Palette").

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

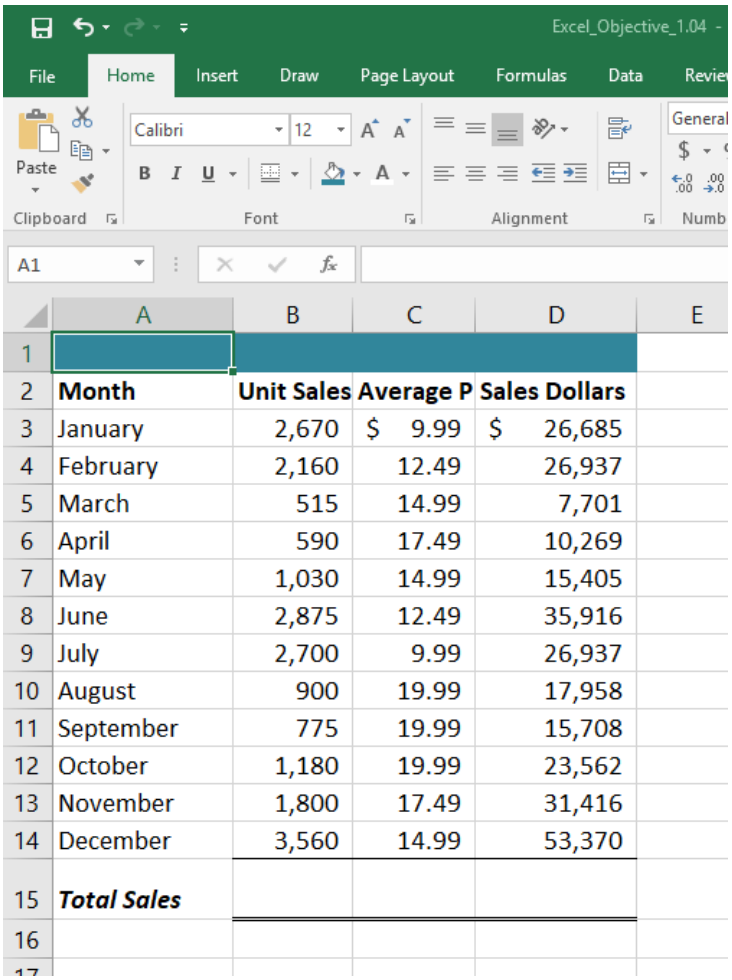
Figure 1.38 Fill Color Palette



19. Click any of the blue color, darker 25% from the palette (see Figure 1.38 "Fill Color Palette").
20. Notice that as you move the mouse pointer over the color palette, you will see a preview of how the color will appear in the highlighted cells.
21. Click the down arrow next to the Font Color button in the Font group of commands in the Home tab of the Ribbon (see Figure 1.36 "Font Group of Commands"), and select White for the font color. This change will be visible once text is typed into the highlighted cells.
22. Click the Increase Font Size button in the Font group of commands in the Home tab of the Ribbon (see Figure 1.38 "Fill Color Palette"). Each click will increase the font size by 1 point.
23. Highlight the range A1:D15 by placing the mouse pointer over cell A1 and left clicking and dragging down to cell D15.
24. Click the drop-down arrow on the right side of the Font button in the Home tab of the Ribbon (see Figure 1.36 "Font Group of Commands").
25. Notice that as you move the mouse pointer over the font style options, you can see the font change in the highlighted cells.
26. Expand the row width of Column D to 10characters.Figure 1.39 "Formatting Techniques Applied" shows how the Sheet1 worksheet should appear after the formatting techniques are applied.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 1.39 Formatting Techniques Applied



	A	B	C	D	E
1					
2	**Month**	**Unit Sales**	**Average P**	**Sales Dollars**	
3	January	2,670	$ 9.99	$ 26,685	
4	February	2,160	12.49	26,937	
5	March	515	14.99	7,701	
6	April	590	17.49	10,269	
7	May	1,030	14.99	15,405	
8	June	2,875	12.49	35,916	
9	July	2,700	9.99	26,937	
10	August	900	19.99	17,958	
11	September	775	19.99	15,708	
12	October	1,180	19.99	23,562	
13	November	1,800	17.49	31,416	
14	December	3,560	14.99	53,370	
15	***Total Sales***				
16					

Why?

Pound Signs (####) Appear in Columns

When a column is too narrow for a long number, Excel will automatically convert the number to a series of pound signs (####). In the case of words or text data, Excel will only show the characters that fit in the column. However, this is not the case with numeric data because it can give the appearance of a number that is much smaller than what is in the cell. To remove the pound signs, increase the width of the column.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

1.4 Data Alignment

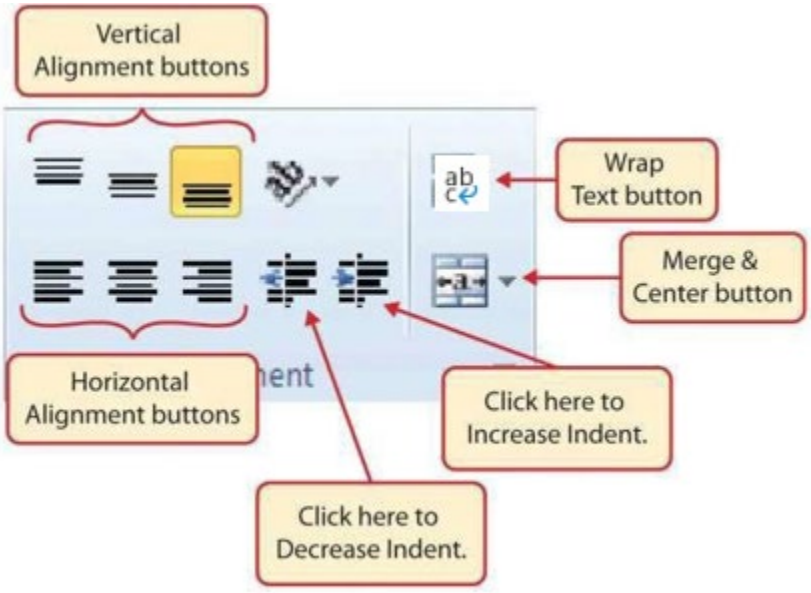
Data Alignment (Wrap Text, Merge Cells, and Center)

Follow-along file: Excel Objective 1.0 (Use file Excel Objective 1.06 if you are starting with this skill.)

The skills presented in this segment show how data are aligned within cell locations. For example, text and numbers can be centered in a cell location, left justified, right justified, and so on. In some cases, you may want to stack multiword text entries vertically in a cell instead of expanding the width of a column. This is referred to as wrapping text. These skills are demonstrated in the following steps:

1. Highlight the range B2:D2 by placing the mouse pointer over cell B2 and left clicking and dragging over to cell D2.
2. Click the Center button in the Alignment group of commands in the Home tab of the Ribbon (see Figure 1.40 "Alignment Group in Home Tab"). This will center the column headings in each cell location.

Figure 1.40 Alignment Group in Home Tab



3. Click the Wrap Text button in the Alignment group (see Figure 1.40 "Alignment Group in Home Tab"). The height of Row 2 automatically expands, and the words that were cut off because the columns were too narrow are now stacked vertically (see Figure 1.42 "Sheet1 with Data Alignment Features Added").

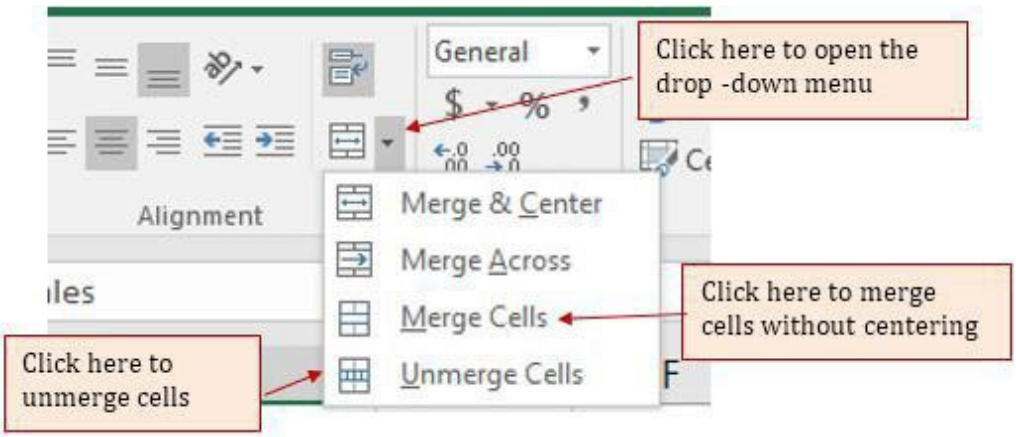
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Keyboard Shortcuts – Wrap Text
• Press the ALT key and then the letters *H* and *W* one at a time.

Why?
Wrap Text The benefit of using the Wrap Text command is that it significantly reduces the need to expand the column width to accommodate multiword column headings. The problem with increasing the column width is that you may reduce the amount of data that can fit on a piece of paper or one screen. This makes it cumbersome to analyze the data in the worksheet and could increase the time it takes to make a decision.

4. Highlight the range A1:D1 by placing the mouse pointer over cell A1 and left clicking and dragging over to cell D1.
5. Click the down arrow on the right side of the Merge & Center button in the Alignment group of commands in the Home tab of the Ribbon.
6. Left click the Merge & Center option (see Figure 1.41 "Merge Cell Drop-Down Menu"). This will create one large cell location running across the top of the dataset with centered text.

Figure 1.41 Merge Cell Drop-Down Menu

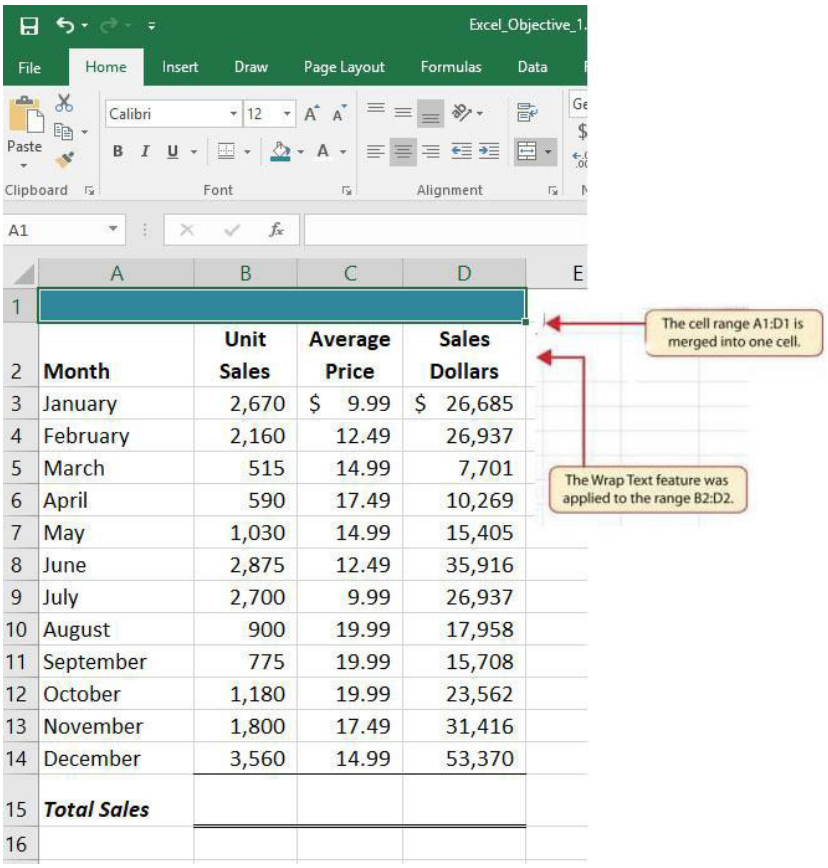


Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Why?
Merge & Center One of the most common reasons the Merge & Center command is used is to center the title of a worksheet directly above the columns of data. Once the cells above the column headings are merged, a title can be centered above the columns of data. It is very difficult to center the title over the columns of data if the cells are not merged.

Figure 1.42 "Sheet1 with Data Alignment Features Added" shows the Sheet1 worksheet with the data alignment commands applied. The reason for merging the cells in the range A1:D1 will become apparent in the next segment.

Figure 1.42 Sheet1 with Data Alignment Features Added



	A	B	C	D
1				
2	**Month**	**Unit Sales**	**Average Price**	**Sales Dollars**
3	January	2,670	$ 9.99	$ 26,685
4	February	2,160	12.49	26,937
5	March	515	14.99	7,701
6	April	590	17.49	10,269
7	May	1,030	14.99	15,405
8	June	2,875	12.49	35,916
9	July	2,700	9.99	26,937
10	August	900	19.99	17,958
11	September	775	19.99	15,708
12	October	1,180	19.99	23,562
13	November	1,800	17.49	31,416
14	December	3,560	14.99	53,370
15	***Total Sales***			
16				

Skill Refresher – Merge Cells
1. Highlight a range of cells that will be merged. 2. Click the Home tab of the Ribbon. 3. Click the Merge & Center button.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Creating Multi-Line Worksheet Titles

Your worksheets need to tell their story without a person there to explain them. They need to be clearly labeled and formatted for ease of understanding. However, one important part of the story that often gets left out is the title of the story. All worksheets should include an informative title that describes the contents of the worksheet and the date, or range of dates, the data pertains to. We will include a title.

Follow-along file: Excel Objective 1.0 (Use file Excel Objective 1.07 if you are starting with this skill.)

In the Sheet1 worksheet, the cells in the range A1:D1 were merged for the purposes of adding a title to the worksheet. This title will require that three lines of text be entered into a cell. The following steps explain how you can enter text into a cell and determine where you want the second line of text to begin:

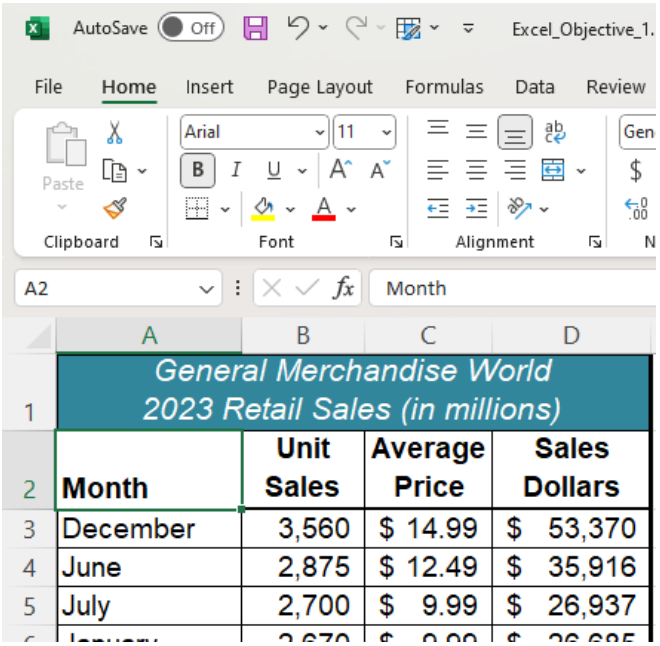
1. Activate cell A1 in the Sheet1 worksheet by placing the mouse pointer over cell A1 and clicking the left mouse button. Since the cells were merged, clicking cell A1 will automatically activate the range A1:D1.
2. Type the text **General Merchandise World**.
3. Hold down the ALT key and press the ENTER key. This will start a new line of text in this cell location.

Excel for Mac – Inserting a line in a cell
Hold the Control and Option + and press return

4. Type the text **2025 Retail Sales (in millions)** and press the ENTER key.
5. Select cell A1. Then click the Italics button in the Font group of commands in the Home tab of the Ribbon.
6. Increase the height of Row 1 to 30 points. Once the row height is increased, all the text typed into the cell will be visible (see Figure 1.43 "Title Added to the Sheet1 Worksheet").

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 1.43 Title Added to the Sheet1 Worksheet



Skill Refresher - Entering Multiple Lines of Text

1. Activate a cell location.
2. Type the first line of text.
3. Hold down the ALT key and press the ENTER key.
4. Type the second line of text and press the ENTER key.

Borders (Adding Lines to a Worksheet)

Follow-along file: Excel Objective 1.0 (Use file Excel Objective 1.08 if you are starting with this skill.)

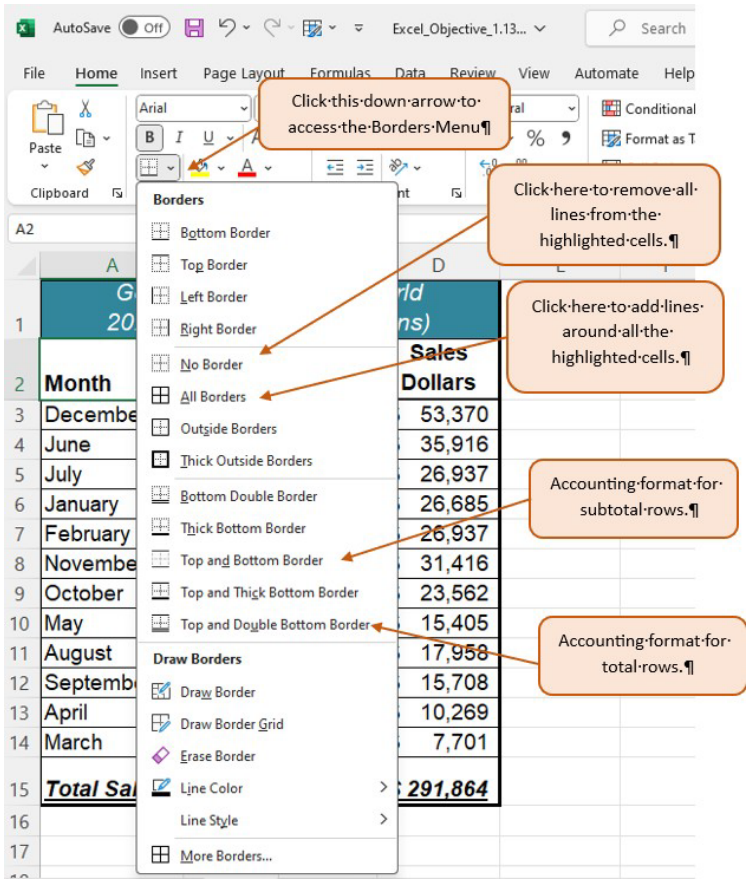
In Excel, adding custom lines to a worksheet is known as adding borders. Borders are different from the grid lines that appear on a worksheet and that define the perimeter of the cell locations. The Borders command lets you add a variety of line styles to a worksheet that can make reading the worksheet much easier.

The following steps illustrate methods for adding preset borders and custom borders to a worksheet:

1. Highlight cells A2:D2.
2. Click the down arrow to the right of the Borders button in the Font group of commands in the Home page of the Ribbon (see Figure 1.44 "Borders Drop-Down Menu").

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 1.44 Borders Drop-Down Menu



3. Left click the All Borders option from the Borders drop-down menu (see Figure 1.44 "Borders Drop- Down Menu"). This will add vertical and horizontal lines to the range A2:D2.
4. Highlight the range A2:D2 by placing the mouse pointer over cell A2 and left clicking and dragging over to cell D2.
5. Click the down arrow to the right of the Borders button.
6. Left click the Thick Bottom Border option from the Borders drop-down menu.
7. Highlight the range A1:D15.
8. Click the down arrow to the right of the Borders button. At the bottom of the Borders dialog box select More Borders
9. This will open the Format Cells dialog box (see Figure 1.45 "Borders Tab of the Format Cells Dialog Box"). You can access all formatting commands in Excel through this dialog box.
10. In the Style section of the Borders tab, left click the thickest line style (see Figure 1.45 "Borders Tab of the Format Cells Dialog Box").

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

11. Left click the Outline button in the Presets section (see Figure 1.45 "Borders Tab of the Format Cells Dialog Box").
12. Click the OK button at the bottom of the dialog box (see Figure 1.45 "Borders Tab of the Format Cells Dialog Box").

Figure 1.45 Borders Tab of the Format Cells Dialog Box

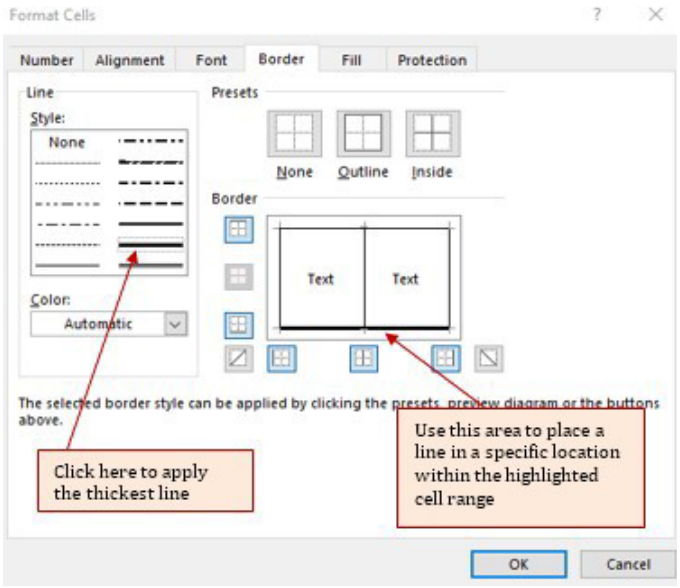


Figure 1.46 Borders Added to the Sheet1 Worksheet

	A	B	C	D
1	*General Merchandise World 2023 Retail Sales (in millions)*			
2	**Month**	**Unit Sales**	**Average Price**	**Sales Dollars**
3	January	2,670	$ 9.99	$ 26,685
4	February	2,160	12.49	26,937
5	March	515	14.99	7,701
6	April	590	17.49	10,269
7	May	1,030	14.99	15,405
8	June	2,875	12.49	35,916
9	July	2,700	9.99	26,937
10	August	900	19.99	17,958
11	September	775	19.99	15,708
12	October	1,180	19.99	23,562
13	November	1,800	17.49	31,416
14	December	3,560	14.99	53,370
15	***Total Sales***			

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Skill Refresher – Preset Borders
1. Highlight a range of cells that require borders. 2. Click the Home tab of the Ribbon. 3. Click the down arrow next to the Borders button. 4. Select an option from the preset borders list.

Skill Refresher – Custom Borders
1. Highlight a range of cells that require borders. Click the Home tab of the Ribbon. 2. Click the down arrow next to the Borders button. 3. Select the More Borders option at the bottom of the options list. 4. Select a line style and line color. 5. Select a placement option. 6. Click the OK button on the dialog box.

AutoSum

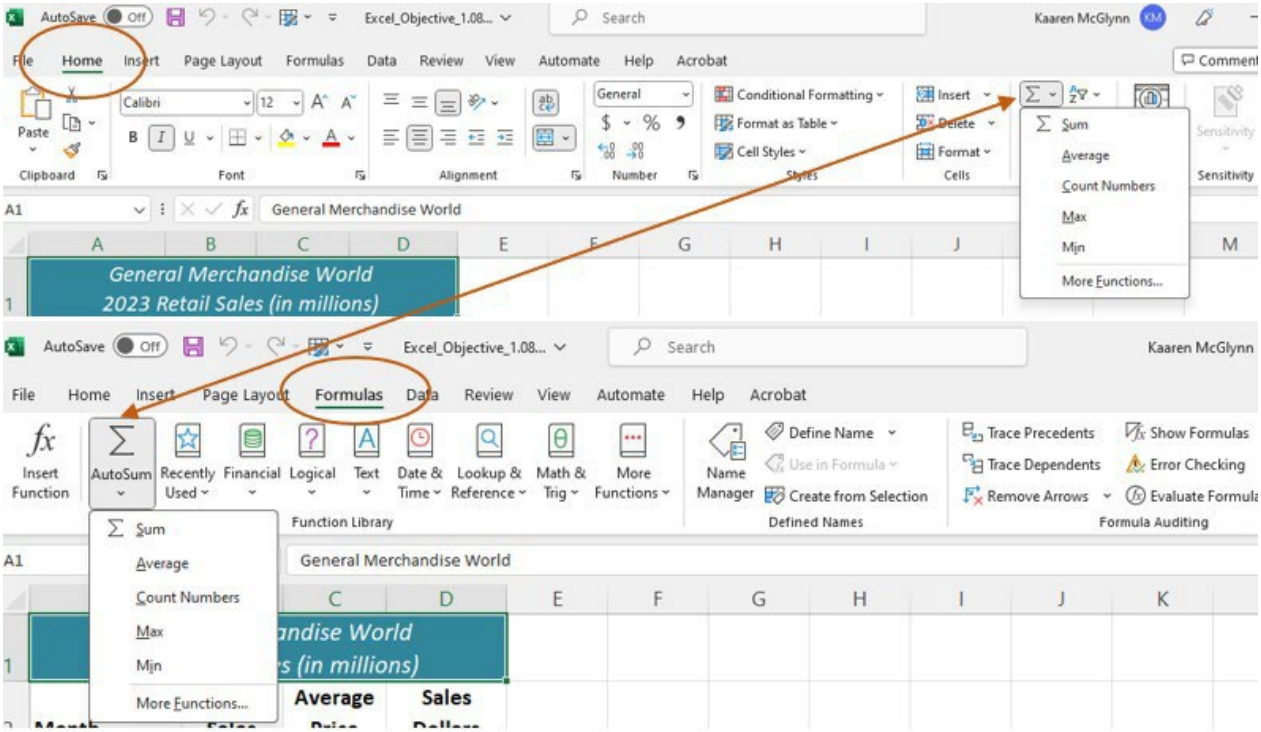
Follow-along file: Excel Objective 1.0 (Use file Excel Objective 1.09 if you are starting with this skill.)

You will see at the bottom of Figure 1.46 "Borders Added to the Sheet1 Worksheet" that Row 15 is intended to show the totals for the data in this worksheet. Applying mathematical computations to a range of cells is accomplished through functions in Excel. Chapter 2 "Mathematical Computations" will review mathematical formulas and functions in detail. However, the following steps will demonstrate how you can quickly sum the values in a column of data using the AutoSum command:

1. Activate cell B15 in the Sheet1worksheet.
2. From the right side of the Home Ribbon, or the left side of the Formula ribbon, click the down arrow next to the AutoSum button. You will see that AutoSum can sum, average, count numbers, and create Max and Min functions.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 1.47 AutoSum Drop-Down List



3. The default command for AutoSum is Sum. Select Sum from the drop-down list.(see Figure 1.47 "AutoSum Drop-Down List"). Note that the AutoSum button can also be found in the Editing group of commands in the Home tab of the Ribbon.

4. Excel will provide a total for the values in the Unit Sales column.

5. Click in cell D15 and click the AutoSum button. You will see that with this sum the Accounting format ($) has been applied to your total row. Excel will copy the formatting from your top row as the default number format for your total row. (*Note: you should not add the Average Price column because it is only a list of prices.)*

Figure 1.48 Totals Added to the Sheet1 Worksheet

	A	B	C	D
1	*General Merchandise World 2025 Retail Sales (in millions)*			
2	**Month**	**Unit Sales**	**Average Price**	**Sales Dollars**
3	January	2,670	$ 9.99	$ 26,685
4	February	2,160	12.49	26,937
5	March	515	14.99	7,701
6	April	590	17.49	10,269
7	May	1,030	14.99	15,405
8	June	2,875	12.49	35,916
9	July	2,700	9.99	26,937
10	August	900	19.99	17,958
11	September	775	19.99	15,708
12	October	1,180	19.99	23,562
13	November	1,800	17.49	31,416
14	December	3,560	14.99	53,370
15	***Total Sales***	***20,755***		***$ 291,864***
16				

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

1.5 Simple Chart

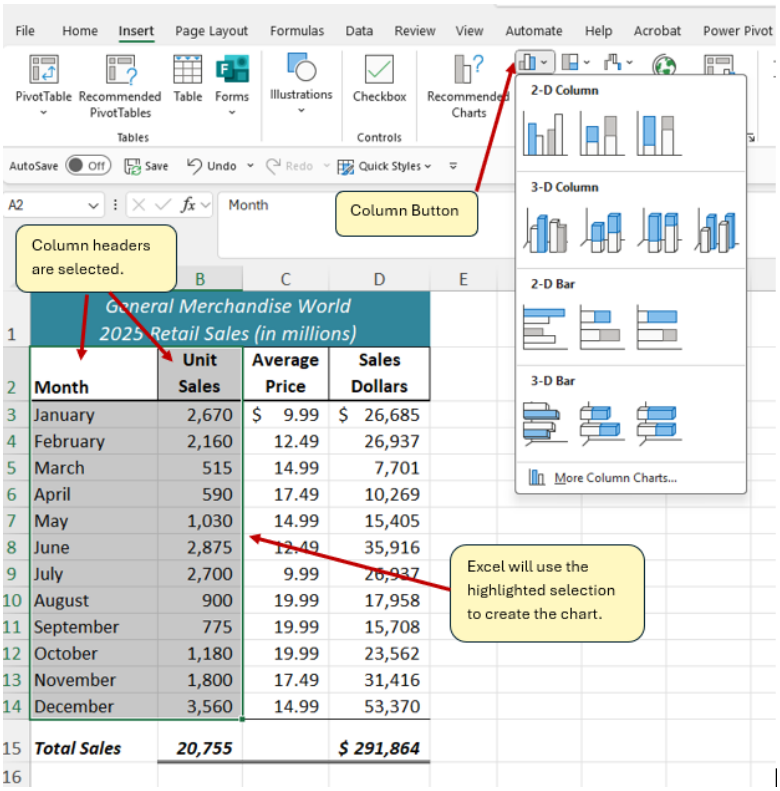
Inserting a Column Chart

Follow-along file: Excel Objective 1.0 (Use file Excel Objective 1.10 if you are starting with this skill.)

As mentioned at the beginning of this chapter, Excel serves as a critical tool for making decisions in both personal and professional contexts. Charts are a powerful tool in Excel that allow you to graphically display the data in a worksheet. Graphical displays allow the reader to immediately identify key trends and behaviors in the data that is being analyzed. For the workbook that we are using for this chapter, understanding the trends in monthly sales data is critical for making decisions such as how many staff members to assign to the store for each month as well as supplying the store with enough inventory to accommodate expected sales. To assist the reader in analyzing this data, a column chart will be created to graphically display the data. It is important for you to plan which type of chart will best display the data so your readers can quickly see key trends. More details on creating charts and on chart types will be presented in a later chapter. The following steps are an introduction to creating the column chart required for this chapter's objective:

1. Highlight the range A2:B14.
2. Click the Insert tab of the Ribbon.
3. Click the Column button (see Figure 1.49 "Column Chart Drop-Down Menu"). This will open the column chart drop-down menu of options.
4. Select the Clustered Column option from the list of column chart options (see Figure 1.49 "Column Chart Drop-Down Menu"). This will create an *embedded chart* in the Sheet1 worksheet (see Figure 1.50 "Embedded Column Chart in Sheet1"). Embedded means that the chart is on the worksheet that contains the original chart data. The chart is floating on the top of the worksheet and can be moved and sized on the face of the worksheet.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International


File Home Insert Page Layout Formulas Data Review View Automate Help Acrobat Power Pivot
PivotTable Recommended PivotTables Table Forms Illustrations Checkbox Recommended Charts
Tables Controls
AutoSave Off Save Undo Redo Quick Styles
A2 Month
Column Button
Column headers are selected.
2-D Column
3-D Column
2-D Bar
3-D Bar
More Column Charts...
General Merchandise World 2025 Retail Sales (in millions)
Excel will use the highlighted selection to create the chart.

Month	Unit Sales	Average Price	Sales Dollars
January	2,670	$ 9.99	$ 26,685
February	2,160	12.49	26,937
March	515	14.99	7,701
April	590	17.49	10,269
May	1,030	14.99	15,405
June	2,875	12.49	35,916
July	2,700	9.99	26,937
August	900	19.99	17,958
September	775	19.99	15,708
October	1,180	19.99	23,562
November	1,800	17.49	31,416
December	3,560	14.99	53,370
Total Sales	***20,755***		***$ 291,864***

Figure 1.49 Column Chart Drop-Down Menu

Figure 1.50 "Embedded Column Chart in Sheet1" shows the column chart that is created once a selection is made from the column chart drop-down menu. Notice that there are two new tabs added to the Ribbon. These tabs contain features for enhancing the appearance and construction of Excel charts. These commands will be covered in more detail in a later chapter. For now, you will see that Excel places the chart over the data in the worksheet. The following steps explain how to move and resize the chart:

Figure 1.50 Embedded Column Chart in Sheet1

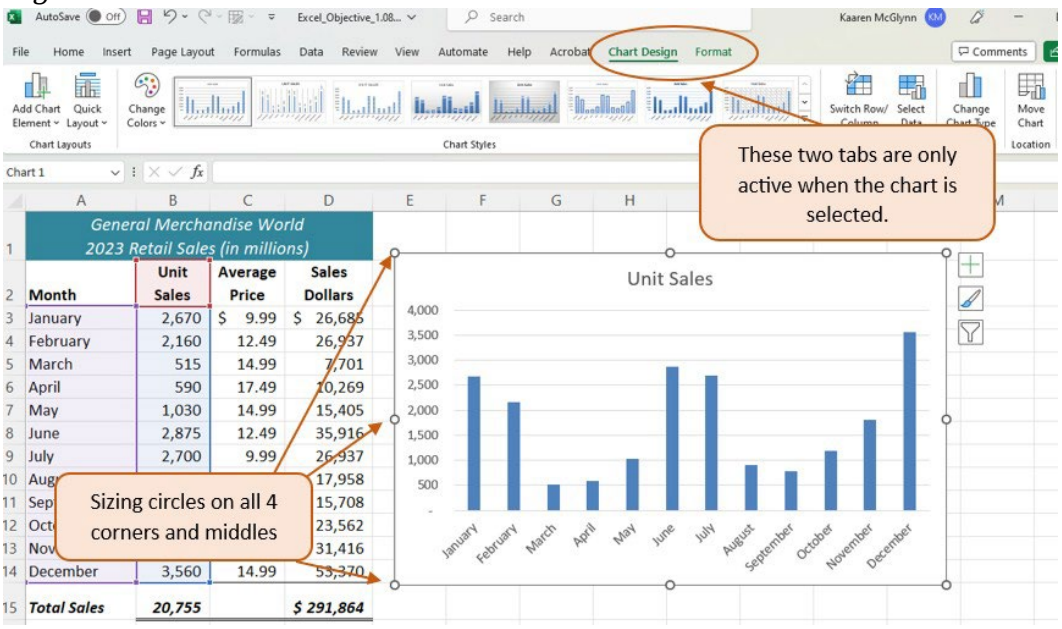


Chart Design Format
These two tabs are only active when the chart is selected.
General Merchandise World 2023 Retail Sales (in millions)
Unit Sales
Sizing circles on all 4 corners and middles
January February March April May June July August September October November December

Month	Unit Sales	Average Price	Sales Dollars
January	2,670	$ 9.99	$ 26,685
February	2,160	12.49	26,937
March	515	14.99	7,701
April	590	17.49	10,269
May	1,030	14.99	15,405
June	2,875	12.49	35,916
July	2,700	9.99	26,937
Aug			17,958
Sep			15,708
Oct			23,562
Nov			31,416
December	3,560	14.99	53,370
Total Sales	***20,755***		***$ 291,864***

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

5. While the chart is selected (buttons are visible around the outside of the chart), left click anywhere it the chart and drag the chart so the upper left corner is placed in the middle of cell F1
6. Place the mouse pointer over the top center sizing handle (see Figure 1.50 "Embedded Column Chart in Sheet1"). You will see the mouse pointer change from a white block plus sign to a vertical double arrow. Make sure the mouse pointer is not in the cross-arrow mode as this will move the chart instead of resizing it.
7. While holding down the ALT key on your keyboard, left click and drag the mouse pointer slightly up. The chart will automatically adjust up to the top of Row 1.
8. Place the mouse pointer over the left center sizing handle.
9. While holding down the ALT key on your keyboard, left click and drag the mouse slightly toward the left. The chart will automatically adjust to the left side of Column F.
10. Place the mouse pointer over the lower center sizing handle.
11. While holding down the ALT key on your keyboard, left click and drag the mouse slightly down. The chart will automatically adjust to the bottom of Row14.
12. Place the mouse pointer over the right center sizing handle.
13. While holding down the ALT key on your keyboard, left click and drag the mouse slightly to the right. The chart will automatically adjust to the right side of Column M.

Why?
There Are No Sizing Handles on a Chart If you do not see the dots or sizing handles around the perimeter of a chart, it could be that the chart is not activated. To activate a chart, left click anywhere on the chart.

Figure 1.52 "Embedded Chart Moved and Resized" shows the column chart moved and resized. Notice that the sizing handles are not visible around the perimeter of the chart. This is because the chart is not activated. Once you click anywhere on the worksheet outside the chart area, the chart is automatically deactivated.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

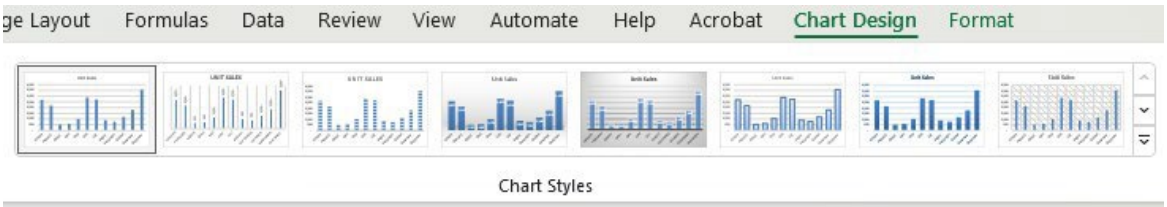
Figure 1.52 Embedded Chart Moved and Resized

Why?
Use the ALT Key When Resizing a Chart Using the ALT key while resizing an embedded chart locks the perimeter of the chart to the columns and rows of the worksheet. This gives you the ability to adjust the chart to precise sizes as you adjust the width and height of the worksheet rows and columns

As shown in Figure 1.50 "Embedded Column Chart in Sheet1", when a chart is created, two tabs are added to the Ribbon. The following steps explain how to use a few of the formatting and design features in these tabs:

1. Check to make sure the column chart in Sheet1 is activated. To activate the chart, left click anywhere on the chart.
2. Click the Design tab under the Chart Tools set of tabs on the Ribbon.
3. Click the down arrow on the right side of the Chart Styles section (see Figure 1.53 "Chart Styles in the Design Tab").

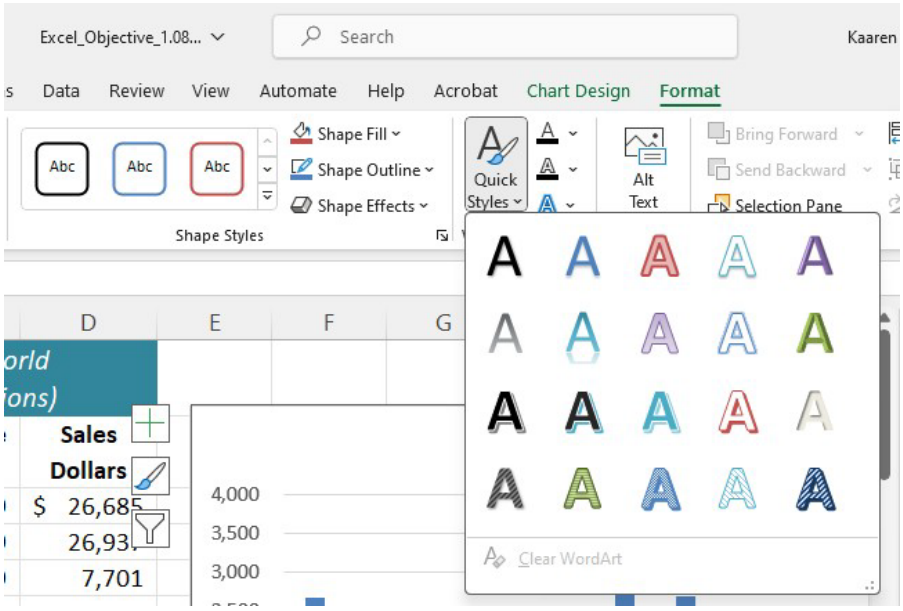
Figure 1.53 Chart Styles in the Design Tab



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

4. Click Style 9 in the Chart Styles section. This style has a black background with blue columns (see Figure 1.53 "Chart Styles in the Design Tab").
5. Click the Format tab under the Chart Tools set of tabs on theRibbon.
6. Click the down arrow on the Quick Styles of the WordArt Styles section (see Figure 1.54).

Figure 1.54 WordArt Styles in the Format Tab



7. Click the Blue, Accent 1, Inner Shadow option Notice that as you move the mouse pointer over the WordArt Styles options, the format of the chart title as well as theX and Y axis titles changes.

Figure 1.55 "Formatting Features Applied to the Column Chart" shows the embedded column chart with the formatting features applied. This chart is very effective in displaying the Unit Sales trends for this company. You can see very quickly that the tallest bar in the chart is the month of December, followed by the months of June, July, January, and February.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 1.55 Formatting Features Applied to the Column Chart

Skill Refresher – Creating a Column Chart

1. Highlight a range of cells that contain data that will be used to create the chart.
2. Click the Insert tab of the Ribbon.
3. Click the Column button in the Charts group.
4. Select an option from the Column drop-down menu.

Cut, Copy, and Paste

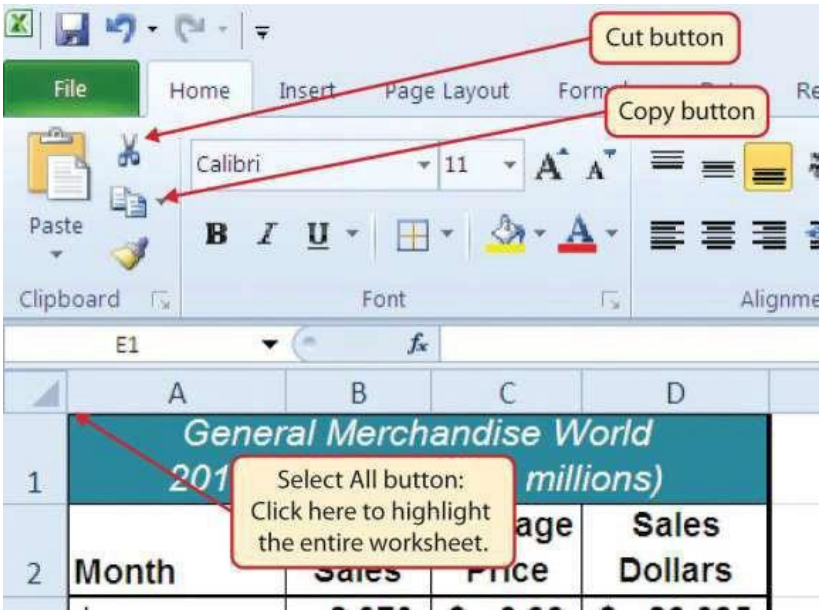
Follow-along file: Excel Objective 1.0 (Use file Excel Objective 1.11 if you are starting with this skill.)

The Cut, Copy, and Paste commands are perhaps the most widely used commands in Microsoft Office. Regarding Excel, the Copy and Paste commands are often used to make copies of worksheets for developing different scenarios or versions for the data being analyzed. The following steps demonstrate how these commands are used for the objective in this chapter:

1. Click the Select All button in the upper left corner of the Sheet1 worksheet (see Figure 1.56 "Clipboard Group of Commands").

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 1.56 Clipboard Group of Commands



2. Click the Copy button in the Clipboard group of commands in the Home tab of the Ribbon (see Figure 1.56 "Clipboard Group of Commands").

Keyboard Shortcuts – Command: Copy
• Press the CTRL key and then the letter *C* key on your keyboard.

3. Create a new worksheet by clicking on the **+** button to the right of the Sheet1 tab.

4. Activate cell location A1.
5. Click the Paste button in the Clipboard group of commands in the Home tab of the Ribbon. Be sure to click the upper area of the Paste button and not the down arrow at the bottom of the button. A copy of Sheet1 will now appear inSheet2.

Keyboard Shortcuts- Paste
• Press the CTRL key and then the letter V key on your keyboard.

6. Click anywhere on the chart in the Sheet2worksheet.
7. Click the Cut button in the Clipboard group on the Home tab of the Ribbon. This will remove the chart from the Sheet2 worksheet.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Keyboard Shortcuts - Cut
• Press the CTRL key and then the letter *X* key on your keyboard.

8. Open the Sheet3 worksheet by left clicking on the Sheet3 worksheet tab at the bottom of the workbook.
9. Activate cell location A1.
10. Click the Paste button in the Home tab of the Ribbon. This will paste the chart from the Sheet2 worksheet into the Sheet3 worksheet.

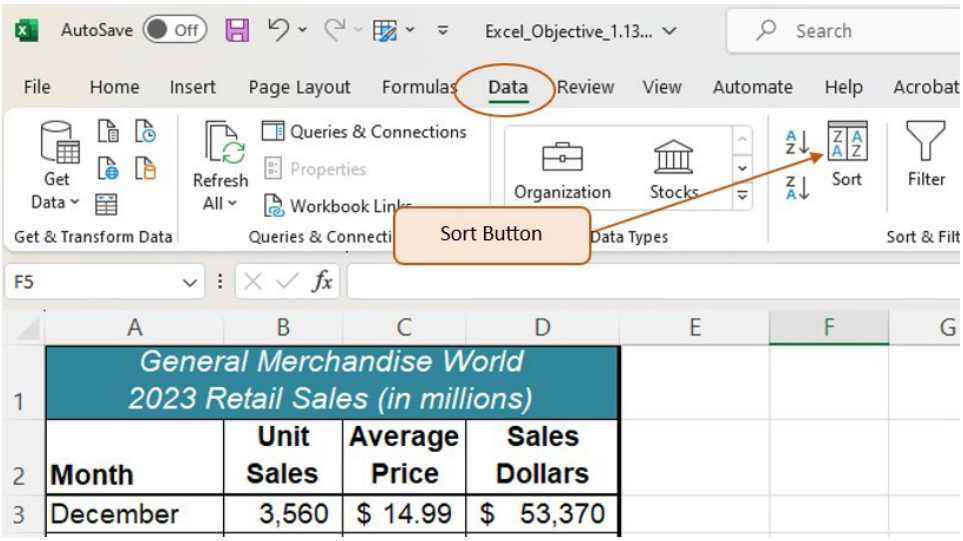
Sorting Data (One Level)

Follow-along file: Excel Objective 1.0 (Use file Excel Objective 1.12 if you are starting with this skill.)

As mentioned earlier in this section, a chart is a tool that enables worksheet readers to analyze data quickly to spot key trends or patterns. Another powerful tool that provides similar benefits is the Sort command. This feature ranks the rows of data in a worksheet based on designated criteria. The following steps demonstrate how the Sort command is used to rank the data in the Sheet2 worksheet:

1. In the Sheet2 worksheet, highlight the range A2:D14
2. Click the Data tab of the Ribbon.
3. Click the Sort button in the Sort & Filter group of commands. This will open the Sort dialog box (see Figure 1.57 "Sort & Filter Group of Commands").

Figure 1.57 Sort & Filter Group of Commands



4. Click the down arrow next to the "Sort by" drop-down box in the Sort dialog box(see Figure 1.58 "Sort Dialog Box"). Make sure the box "My data has headers" ischecked.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 1.58 Sort Dialog Box

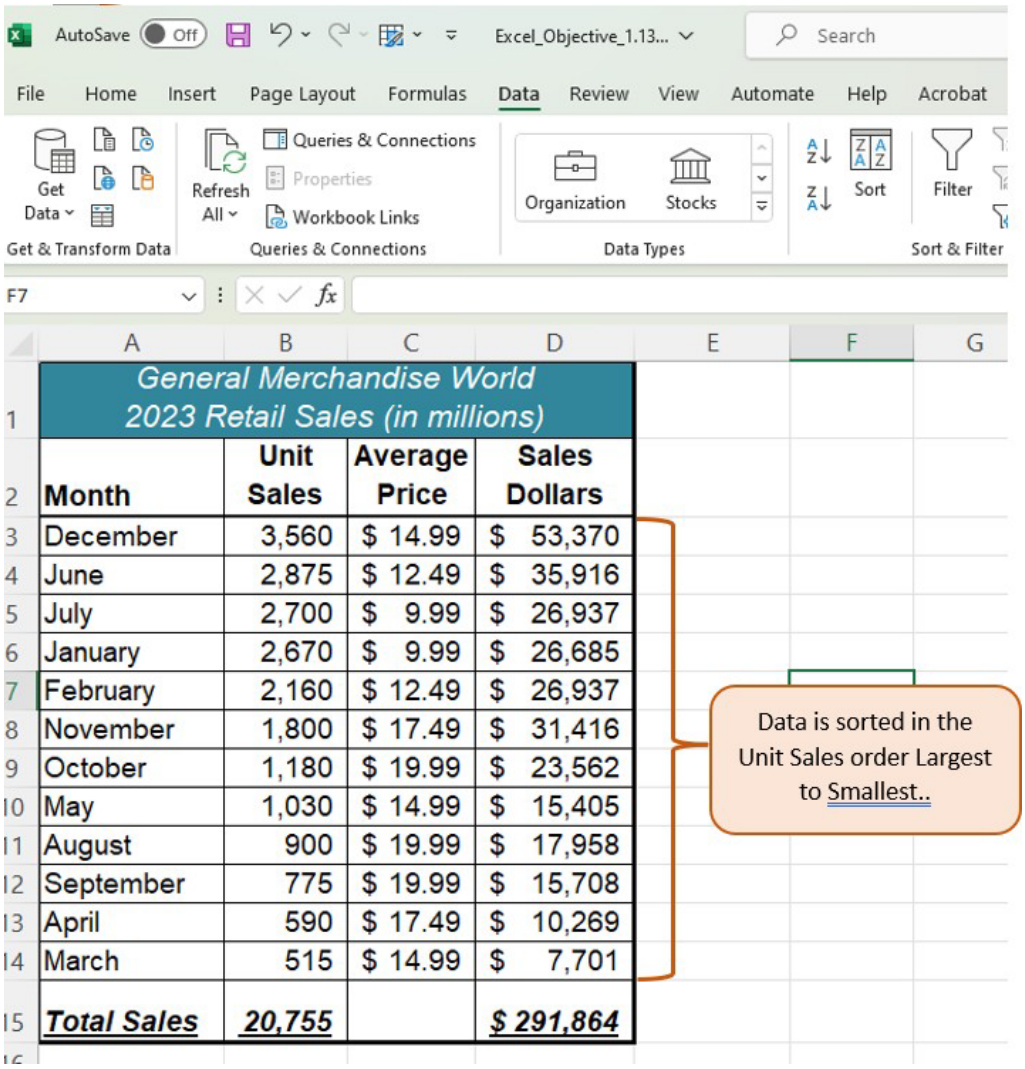
5. Click the Unit Sales option from the drop-down list.
6. Click the down arrow next to the Order drop-down box.
7. Click Largest to Smallest from the drop-down list.
8. Click the OK button at the bottom of the Sort dialog box. The data in the range A2:D14 will now be sorted in descending order based on the values in the Unit Sales column. (*Note that when you perform the sort, your chart will automatically change to match the new sorted data.)*

Integrity Check – Sorting Data
Carefully check the data you are sorting. It is critical that all columns are in a contiguous range of data before sorting. If Excel detects that you are trying to sort only part of a contiguous range of data, it will give you a warning dialog box.

Figure 1.59 "Data Sorted Based on Unit Sales" shows the data in the Sheet2 worksheet sorted based on the values in the Unit Sales column. Like the chart, the Sort command makes it easy to identify the months of the year with the highest unit sales.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 1.59 Data Sorted Based on Unit Sales



Month	Unit Sales	Average Price	Sales Dollars
December	3,560	$ 14.99	$ 53,370
June	2,875	$ 12.49	$ 35,916
July	2,700	$ 9.99	$ 26,937
January	2,670	$ 9.99	$ 26,685
February	2,160	$ 12.49	$ 26,937
November	1,800	$ 17.49	$ 31,416
October	1,180	$ 19.99	$ 23,562
May	1,030	$ 14.99	$ 15,405
August	900	$ 19.99	$ 17,958
September	775	$ 19.99	$ 15,708
April	590	$ 17.49	$ 10,269
March	515	$ 14.99	$ 7,701
Total Sales	***20,755***		***$ 291,864***

Skill Refresher – Sorting Data (One Level)

1. Make any cell active in a range of contiguous cells to be sorted.
2. Click the Data tab of the Ribbon.
3. Click the Sort button in the Sort & Filter group.
4. Select a column from the "Sort by" drop-downlist.
5. Select a sort order from the Order drop-downlist.
6. Click the OK button on the Sort dialog box.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

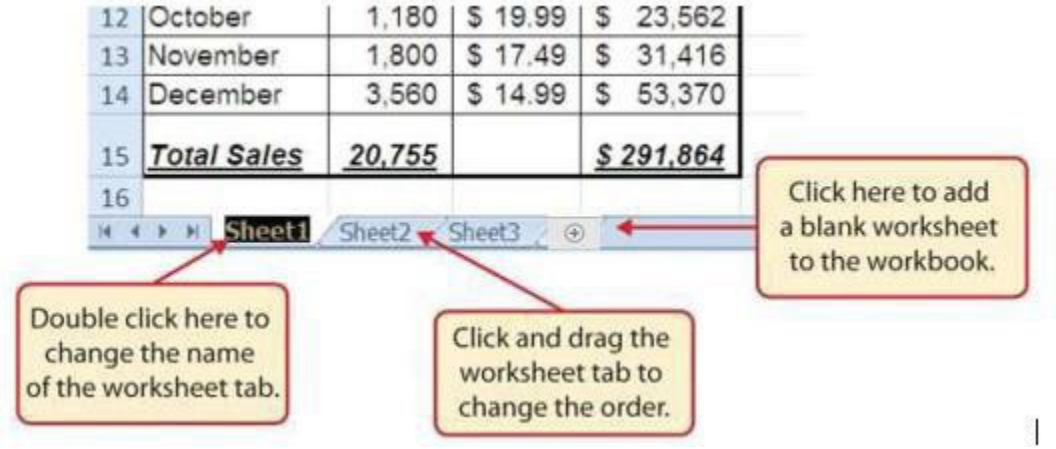
Moving, Renaming, Inserting, and Deleting Worksheets

Follow-along file: Excel Objective 1.0 (Use file Excel Objective 1.13 if you are starting with this skill.)

The default names for the worksheet tabs at the bottom of workbook are Sheet1, Sheet2, and so on. However, you can change the worksheet tab names to identify the data you are using in a workbook. Additionally, you can change the order in which the worksheet tabs appear in the workbook. The following steps explain how to rename and move the worksheets in a workbook:

1. With the left mouse button, double click the Sheet1 worksheet tab at the bottom of the workbook (see Figure 1.60 "Renaming a Worksheet Tab"). NOTE: This screenshot is an older version of Excel. In the 2016 version, the add worksheet icon is ⊕
2. Type the name **Sales by Month**.
3. Press the ENTER key on your keyboard.
4. With the left mouse button, double click the Sheet2 worksheet tab at the bottom of the workbook.
5. Type the name **Unit Sales Rank**.
6. Press the ENTER key on your keyboard.

Figure 1.60 Renaming a Worksheet Tab


12 October 1,180 $ 19.99 $ 23,562
13 November 1,800 $ 17.49 $ 31,416
14 December 3,560 $ 14.99 $ 53,370
15 Total Sales 20,755 $ 291,864
16
Sheet1
Sheet2
Sheet3
Click here to add a blank worksheet to the workbook.
Double click here to change the name of the worksheet tab.
Click and drag the worksheet tab to change the order.

1. Left click and drag the Unit Sales Rank worksheet tab to the left of the Sales by Month worksheet tab.
2. Right click the Sheet3 worksheet tab. Click Delete to delete the worksheet. Alternatively, you can:
    a. Click the Home tab of the Ribbon.
    b. Click the down arrow on the Delete button in the Cells group of commands.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

c. Click the Delete Sheet option from the drop-down list (see Figure 1.35 "Delete Drop-Down Menu").

d. Click the Delete button on the Delete warning box.

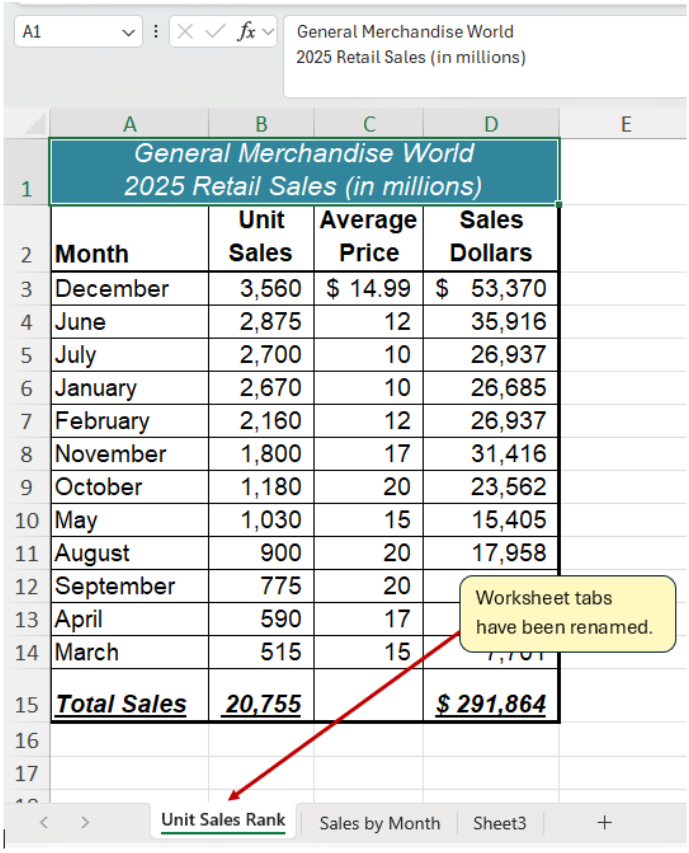
3. Click the Insert Worksheet tab at the bottom of the workbook (see Figure 1.60 "Renaming a Worksheet Tab").

Integrity Check – Deleting Worksheets
Be very cautious when deleting worksheets that contain data. Once a worksheet is deleted, you cannot use the Undo command to bring the sheet back. Deleting a worksheet is a permanent command.

Keyboard Shortcuts - Inserting New Worksheets
• Press the SHIFT key and then the F11 key on your keyboard.

Figure 1.61 "Final Appearance of the Excel Objective 1.0 Workbook" shows the final appearance of the Excel Objective 1.0 workbook after the worksheet tabs have been renamed and moved.

Figure 1.61 Final Appearance of the Excel Objective 1.0 Workbook



	A	B	C	D	E
1	*General Merchandise World 2025 Retail Sales (in millions)*				
2	**Month**	**Unit Sales**	**Average Price**	**Sales Dollars**	
3	December	3,560	$ 14.99	$ 53,370	
4	June	2,875	12	35,916	
5	July	2,700	10	26,937	
6	January	2,670	10	26,685	
7	February	2,160	12	26,937	
8	November	1,800	17	31,416	
9	October	1,180	20	23,562	
10	May	1,030	15	15,405	
11	August	900	20	17,958	
12	September	775	20		
13	April	590	17		
14	March	515	15		
15	***Total Sales***	***20,755***		***$ 291,864***	
16					
17					

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Skill Refresher - Renaming Worksheets

1. Double click the worksheet tab.
2. Type the new name.
3. Press the ENTER key.

Skill Refresher - Moving Worksheets

1. Left click the worksheet tab.
2. Drag it to the desired position.

Skill Refresher – Deleting Worksheets

1. Open the worksheet to be deleted.
2. Click the Home tab of the Ribbon.
3. Click the down arrow on the Delete button.
4. Select the Delete Sheet option.
5. Click Delete on the warning box.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Key Takeaways
• Formatting skills are critical for creating worksheets that are easy to read and have a professional appearance. • A series of pound signs (####) in a cell location indicates that the column is too narrow to display the number entered. • Using the Wrap Text command allows you to stack multiword column headings vertically in a cell location, reducing the need to expand column widths. • Use the Merge & Center command to center the title of a worksheet directly over the columns that contain data. • Adding borders or lines will make your worksheet easier to read and helps to separate the data in each column and row. • Effective charts enable readers to immediately identify key trends in the data you are displaying. command. • You cannot use the Undo command to restore a deleted worksheet. • You cannot use the Undo command to bring back a worksheet that has been deleted

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

EXERCISES

1. The pound signs (####) that appear in a cell location indicate that:
   a. A computational error has occurred.
   b. The AutoSum feature was applied to text data instead of numeric data.
   c. A number is too long for the current width of a column.
   d. You must click the Calculate Sheet command in the Formulas tab of the Ribbon.
2. Which of the following is most accurate with respect to the Wrap Text command?
   a. It allows you to designate which words are placed on a second line in a cell.
   b. It reduces the need to expand the width of the columns in a worksheet.
   c. It converts any numeric data to text data.
   d. It can be accessed only through the right-click menu of options.
3. What is the quickest way to center a title over six columns of data?
   a. Type the title into the cell location over the left-most column and use the space bar to try and place the title over the center of the six columns.
   b. Type the title into the cell location over the left-most column and click the Center alignment button in the Home tab of the Ribbon.
   c. Type the title into the cell location over the third column and use the BACKSPACE key to place the title over the center of the six columns.
   d. Highlight the six cell locations over each of the columns and click the Merge & Center button in the Home tab of the Ribbon.
4. Which of the following is true with respect to deleting worksheets?
   a. You cannot use the Undo button to bring back a worksheet once it has been deleted.
   b. Click the Select All button and press the DELETE key on your keyboard to delete a worksheet from a workbook.
   c. Holding down the SHIFT key while pressing the F11 key on your keyboard will delete a worksheet from your workbook.
   d. Excel will not let you delete a worksheet that contains data. All data must be removed from the worksheet before the worksheet can be deleted.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

1.6 Printing

LEARNING OBJECTIVES
1. Use the Page Layout tab to prepare a worksheet for printing.
2. Add headers and footers to a printed worksheet.
3. Examine how to print worksheets and workbooks.

Once you have completed a workbook, it is good practice to select the appropriate settings for printing. These settings are in the Page Layout tab of the Ribbon and discussed in this section of the chapter.

Page Setup

Follow-along file: Excel Objective 1.0 (Use file Excel Objective 1.14 if you are starting with this skill.)

Before you can properly print the worksheets in a workbook, you must establish appropriate settings. The following steps explain several of the commands in the Page Layout tab of the Ribbon used to prepare a worksheet for printing:

1. Open the Unit Sales Rank worksheet by left clicking on the worksheet tab.
2. Click the Page Layout tab of the Ribbon.
3. Click the Margins button in the Page Setup group of commands. This will open a drop-down list of options for setting the margins of your printed document.
4. Click the Wide option from the Margins drop-down list.
5. Open the Sales by Month worksheet by left clicking on the worksheet tab.
6. Click the Page Layout tab of the Ribbon (see Figure 1.62 "Page Layout Commands for Printing").
7. Click the Margins button in the Page Setup group of commands.
8. Click the Narrow option from the Margins drop-down list.
9. Click the Orientation button in the Page Setup group of commands.
10. Click the Landscape option.
11. Click the down arrow to the right of the Width button in the Scale to Fit group of commands.
12. Click the 1 Page option from the drop-down list.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

13. Click the down arrow to the right of the Height button in the Scale to Fit group of commands.
14. Click the 1 Page option from the drop-down list. This step along with step 12 will automatically reduce the worksheet so that it fits on one piece of paper. It is very common for professionals to create worksheets that fit within the width of the paper being used. However, for long data sets, you may need to set the height to more than one page. Table 1.2 "Printing Resources: Purpose and Use for Page Setup Commands" provides a list of commands found in the Page Layout tab of the Ribbon

Why?
Use Print Settings Because professionals often share Excel workbooks, it is a good practice to select the appropriate print settings in the Page Layout tab even if you do not intend to print the worksheets in a workbook. It can be extremely frustrating for recipients of a workbook who wish to print your worksheets to find that the necessary print settings have not been selected. This may reflect poorly on your attention to detail, especially if the recipient of the workbook is your boss.

Figure 1.62 Page Layout Commands for Printing

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Table 1.2 Printing Resources: Purpose and Use for Page Setup Commands

Command	Purpose	Use
Margins	Sets the top, bottom, right, and left margin space for the printed document	1. Click the Page Layout tab.
		2. Click the Margin button.
		3. Click one of the preset margin options or click Custom Margins.
Orientation	Sets the orientation of the printed document to either portrait or landscape	1. Click the Page Layout tab of the
		2. Click the Orientation button.
		3. Click one of the preset orientations.
Size	Sets the paper size for the printed document	1. Click the Page Layout tab of the
		2. Click the Size button.
		3. Click one of the preset paper size options or click More Paper Sizes.
Print Area	Used for printing only a specific area or range of cells on a worksheet	1. Highlight the range of cells on a worksheet that you wish to print.
		2. Click the Page Layout tab of the
		3. Click the Print Area button.
		4. Click the Set Print Area option from the drop-down list.
Breaks	Allows you to manually set the page breaks on a worksheet	1. Activate a cell on the worksheet where the page break should be placed. Breaks are created above and to the left
		2. Click the Page Layout tab of the
		3. Click the Breaks button.
		4. Click the Insert Page Break option from the drop-down list.
Background	Adds a picture behind the cell locations in a worksheet	1. Click the Page Layout tab of the
		2. Click the Background button.
		3. Select a picture stored on your computer or network.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Command	Purpose	Use
Print Titles	Used when printing large data sets that are several pages long. This command will repeat the column headings at the top of each printed page.	1. Click the Page Layout tab of the
		2. Click the Print Titles button.
		3. Click in the Rows to Repeat at Top input box in the Page Setup dialog box.
		4. Click any cell in the row that contains the column headings for your
		5. Click the OK button at the bottom of the Page Setup dialog box.

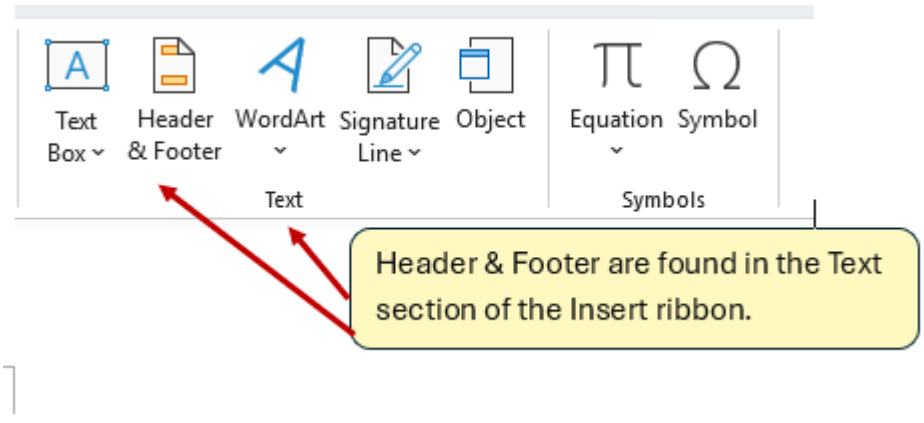
Headers and Footers

Follow-along file: Excel Objective 1.0 (Use file Excel Objective 1.13 if you are starting with this skill.)

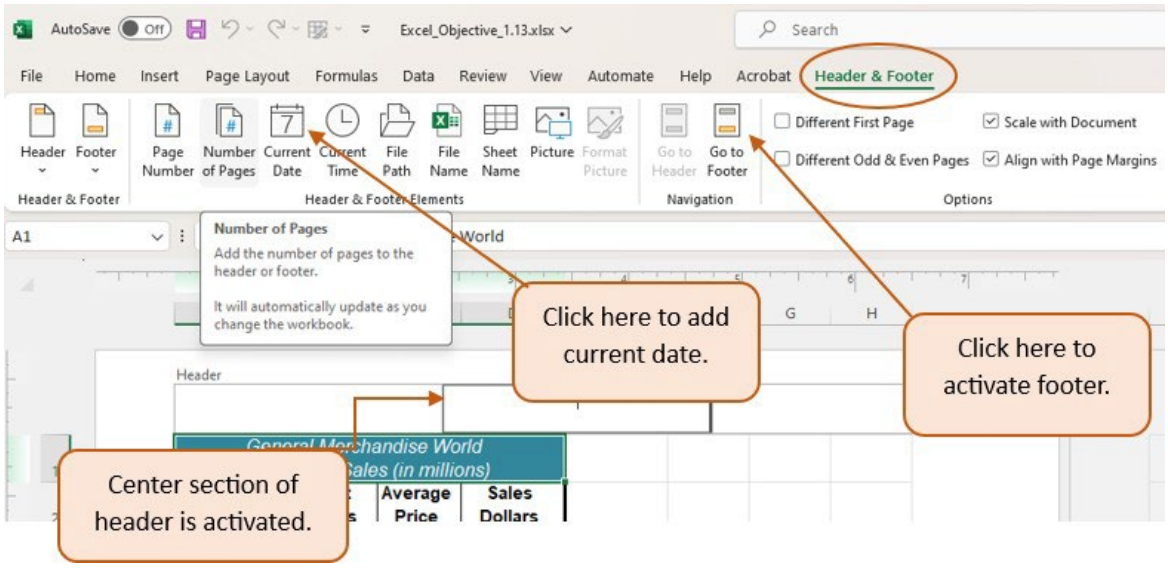
When printing worksheets from Excel, it is common to add headers and footers to the printed document. Information in the header or footer could include the date, page number, file name, company name, and so on. The following steps explain how to add headers and footers to the Excel Objective 1.0 workbook:

1. Open the Unit Sales Rank worksheet by left clicking on the worksheet tab.
2. Click the Insert tab of the Ribbon. (Make sure your Excel window is maximized)
3. Click the Header & Footer button in the Text group of commands. You will see the Design tab added to the Ribbon; this is used for creating the headers and footers for the printed worksheet. Also, this will convert the view of the worksheet from Normal to Page Layout (see Figure 1.63 "Design Tab for Creating Headers and Footers").

Figure 1.63 Design Tab for Creating Headers and Footers



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International



4. Type your name in the center section of the Header.
5. Place the mouse pointer over the left section of the Header and left click (see Figure 1.63 "Design Tab for Creating Headers and Footers").
6. Click the Current Date button in the Header & Footer Elements group of commands in the Design tab of the Ribbon.
7. Click the Go to Footer button in the Navigation group of commands in the Design tab of the Ribbon.
8. Place the mouse pointer over the far-right section of the footer and left click.
9. Click the Page Number button in the Header & Footer Elements group of commands in the Design tab of the Ribbon.
10. Click any cell location outside the header or footer area. The Design tab for creating headers and footers will disappear.
11. Click the Normal view button in the lower right side of the Status Bar.
12. Open the Sales by Month worksheet by left clicking the worksheet tab.
13. Repeat steps 2 through 11 to create the same header and footer for this worksheet.

Printing Worksheets and Workbooks

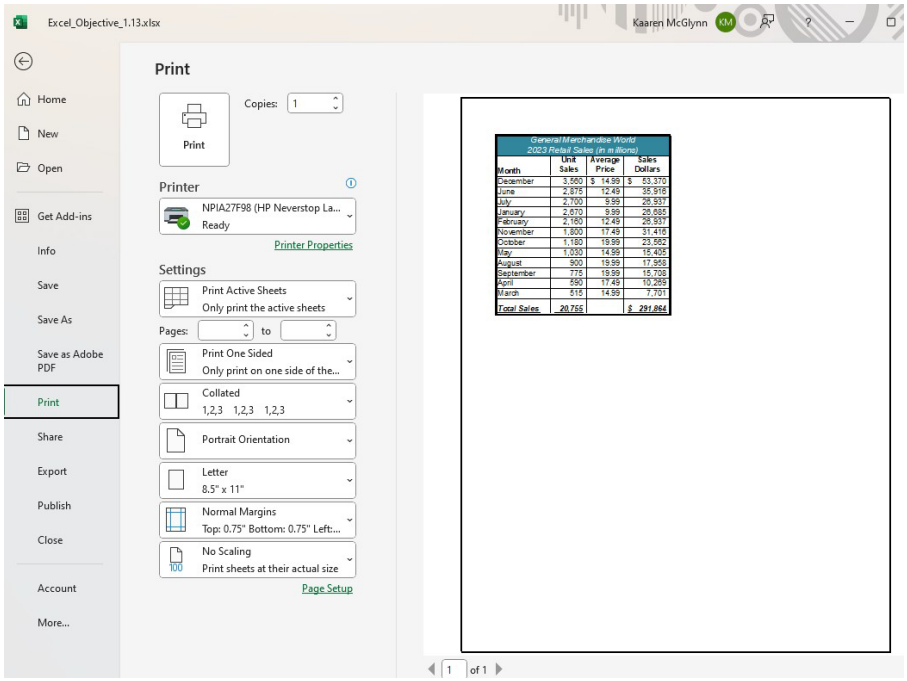
Follow-along file: Excel Objective 1.0 (Use file Excel Objective 1.16 if you are starting with this skill.)

Once you have established the print settings for the worksheets in a workbook and have added headers and footers, you are ready to print your worksheets. The following steps explain how to print the worksheets in the Excel Objective 1.0 workbook:

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

1. Open the Unit Sales Rank worksheet by left clicking on the worksheet tab.
2. Click the File tab on the Ribbon.
3. Click the Print option on the left side of the Backstage view (see Figure 1.65 "Print Preview"). On the right side of the Backstage view, you will be able to see a preview of your printed worksheet.

Figure 1.65 Print Preview



4. Click the Print Active Sheets button in the Print section of the Backstage view (see Figure 1.65 "Print Preview").
5. Click the Print Entire Workbook option from the drop-down list. This will print all worksheets in a workbook when the Print button is clicked.
6. Click the Next Page arrow at the bottom of the preview window.
7. Click the Print button.
8. Click the Home tab of the Ribbon.
9. Save and close the Excel Objective 1.0 workbook.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Key Takeaways

- The commands in the Page Layout tab of the Ribbon are used to prepare a worksheet for printing.
- You can add headers and footers to a worksheet to show key information such as page numbers, the date, the file name, your name, and so on.
- The Print commands are in the File tab of the Ribbon

EXERCISES

1. Which of the following commands is used to print the column headings in a worksheet at the top of each printed page for a worksheet that contains 100 rows of data?
   a. the Header & Footer command in the Insert tab of the Ribbon
   b. the Print Titles command in the Page Layout tab of the Ribbon
   c. the Insert command in the Home tab of the Ribbon
   d. the Conditional Formatting command in the Home tab of the Ribbon.
2. Which of the following is true with respect to printing Excel worksheets?
   a. Setting the Width and Height drop-down lists to 1 Page will ensure that all the worksheets in a workbook are printed on one page.
   b. The page layout settings must be set for each worksheet in a workbook.
   c. You can print only one worksheet at a time in a workbook that contains multiple worksheets.
   d. All of the above are true.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Chapter Assignments and Tests

To assess your understanding of the material covered in the chapter, please complete the following assignments.

Careers in Practice (Skills Review)

Basic Monthly Budget for Medical Office (Comprehensive Review) Starter File: Chapter 1 CiP Exercise 1

Difficulty: Level 1

Creating and maintaining budgets are common practices in many careers. Budgets play a critical role in helping a business or household control expenditures. In this exercise, you will create a budget for a hypothetical medical office while reviewing the skills covered in this chapter. Begin the exercise by opening the file named Chapter 1 CiP Exercise 1.

Entering, Editing, and Managing Data

1. Activate all the cell locations in the Sheet1 worksheet by left clicking the Select All button in the upper left corner of the worksheet.
2. In the Home tab of the Ribbon, set the font style to Arial and the font size to 12 points.
3. Increase the width of Column A so all the entries in the range A3:A8 are visible. Place the mouse pointer between the letter A and letter B of Column A and Column

   B. When the mouse pointer changes to a double arrow, left click and drag it to the right until the character width is approximately 18.00.
4. Enter Quarter 1 in cell B2.
5. Use Auto fill to complete the headings in the range C2:E2. Activate cell B2 and place the mouse pointer over the Fill Handle. When the mouse pointer changes to a black plus sign, left click and drag it to cell E2.
6. Increase the width of Columns B, C, D, and E to approximately 10.14 characters. Highlight the range B2:E2 and click the Format button in the Home tab of the Ribbon. Click the Column Width option, type 10.14 in the Column Width dialog box, and then click the OK button in the Column Width dialog box.
7. Make the following format adjustment to the range A2:E2: bold; and change the cell fill color to orange.
8. Copy cell B3 and paste the contents into the range C3:E3.
9. Copy the contents in the range B6:B8 by highlighting the range and clicking the Copy button in the Home tab of the Ribbon. Then, highlight the range C6:E8 and click the Paste button in the Home tab of the Ribbon.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

10. Insert a blank column between Columns A and B. Activate any cell location in Column B. Then, click the drop-down arrow of the Insert button in the Home tab of the Ribbon. Click the Insert Sheet Columns option. (Alternatively, you can right click and insert column.)
11. Adjust the width of Column B to approximately 13.29 characters. (This may vary depending on your font size.)
12. Enter the words Budget Cost in cell B2.
13. Set the alignment in cell B2 to Wrap Text. Activate the cell location and click the Wrap Text button in the Home tab of the Ribbon.
14. Calculate the total budget for all four quarters for the salaries. Activate cell B3 and click the down arrow on the AutoSum button in the Formulas tab of the Ribbon. Click the Sum option from the drop- down list. Then, highlight the range C3:F3 and press the ENTER key on your keyboard.
15. Copy the contents of cell B3 and paste them into the range B4:B8.
16. Enter the words Medical Office Budget in cell A1. Use Alt-Enter to add a second row. Type Budget 2024 in second row. Then press enter.
17. Merge the cells in the range A1:F1. Highlight the range and click the Merge & Center button in the Home tab of the Ribbon.
18. Make the following format adjustments to the range A1:F1: change the cell fill color to Blue, Accent 1, change the font color to white, change the font size to 14 points; bold; italics.
19. Increase the height of Row 1 to fit the title.
20. Sort the data in the range A2:F8 based on the values in the Quarter 4 column in descending order. Have an active cell anywhere in the range A2:F8 and click the Sort button in the Data tab of the Ribbon. Select Quarter 4 in the "Sort by" drop-down box and select Largest to Smallest in the Order drop-down box. Click the OK button. (Because you have inserted a merged cell title you will need to select the data you want to sort.)
21. Format the range B3:F3 with a US dollar sign. Format the range B4: F8 for comma. (You must click on the comma format on the Home Ribbon)
22. Add vertical and horizontal lines to the range A1:F8. Highlight the range and click the down arrow next to the Borders button in the Home tab of the Ribbon. Select the All Borders option from the drop-down list.
23. Change the name of the Sheet1 worksheet tab to "Budget." Double click the worksheet tab, type the word Budget, and press the ENTER key.

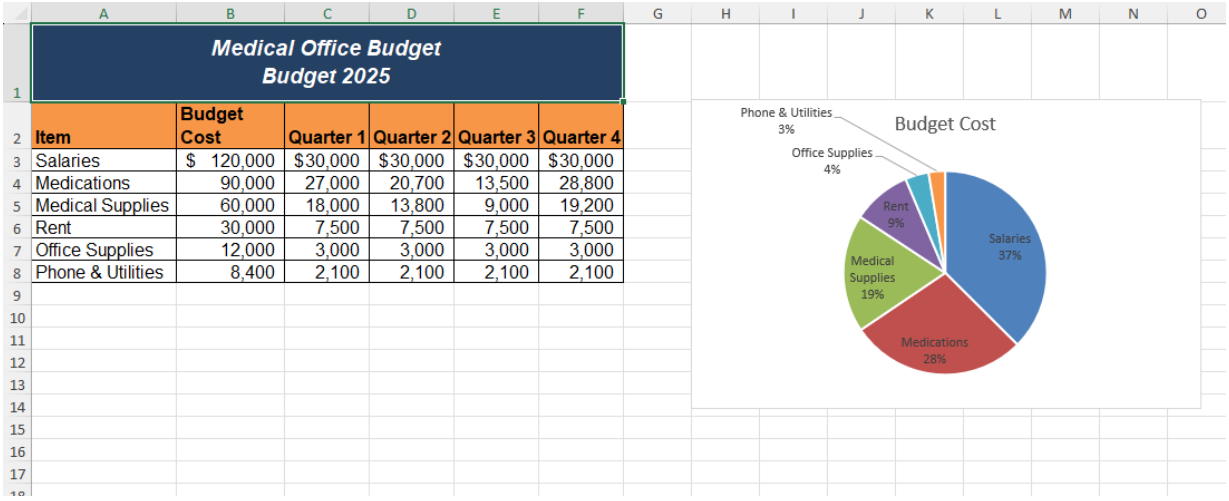
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

24. Insert a pie chart using the data in the range A2:B8. Highlight the range and click the Pie button in the Insert tab of the Ribbon. Click the first option on the list (the Pie option).
25. Click and drag the chart so the upper left corner is in the center of cell H2.
26. Add labels to the chart by clicking the Layout 1 option from the Quick Layouts list in the Design tab of the Ribbon. Make sure the chart is activated by clicking it once before you look for the Chart Layout option.

Printing

27. Change the orientation of the Budget worksheet so it prints landscape instead of portrait.
28. Adjust the appropriate settings so the Budget worksheet prints on one piece of paper.
29. Add a header to the Budget worksheet that shows the date in the upper left corner and your name in the center.
30. Add a footer to the Budget worksheet that shows the page number in the lower right corner.
31. Use the Save As command in the File tab of the Ribbon to save the workbook by adding your name in front of the current workbook name (i.e., "your name Chapter 1 CiP Exercise 1").
32. Close the workbook and Excel.

Figure 1.66 Completed Medical Budget Exercise



Medical Office Budget Budget 2025					
Item	Budget Cost	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Salaries	$ 120,000	$30,000	$30,000	$30,000	$30,000
Medications	90,000	27,000	20,700	13,500	28,800
Medical Supplies	60,000	18,000	13,800	9,000	19,200
Rent	30,000	7,500	7,500	7,500	7,500
Office Supplies	12,000	3,000	3,000	3,000	3,000
Phone & Utilities	8,400	2,100	2,100	2,100	2,100

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Marketing for Specialty Women's Apparel

Starter File: Chapter 1 CiP Exercise 2

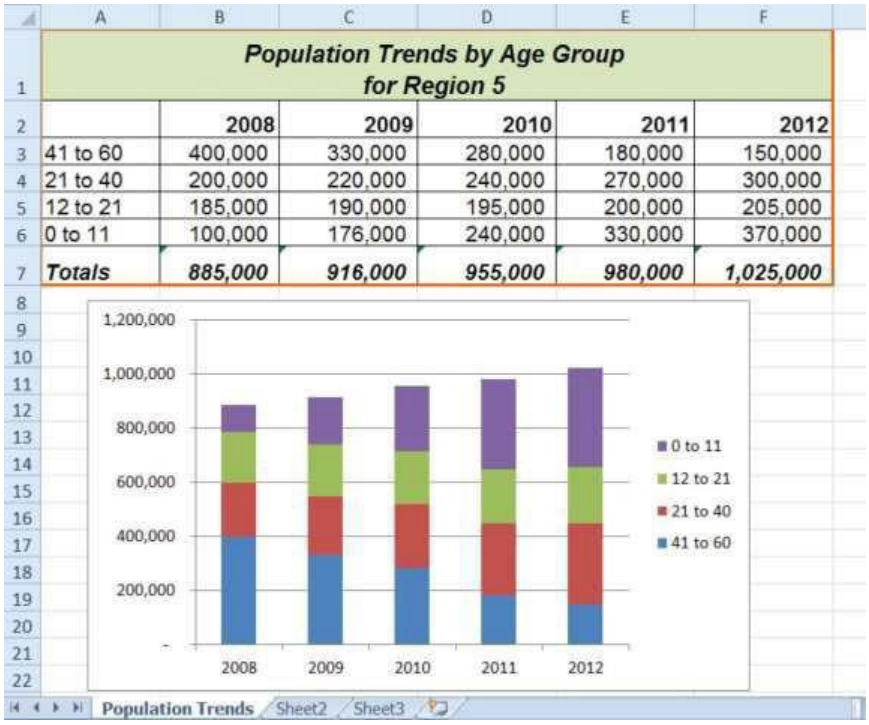
Difficulty: Level 2

A key activity for marketing professionals is to analyze how population demographics change in certain regions. This is especially important for specialty retail stores that target a specific age group within a population. This exercise utilizes the skills covered in this chapter to analyze hypothetical population trends. The decisions that can be made with such information include where to open new stores, whether existing stores should be closed and reopened in other communities, or whether the product assortment should be adjusted. The purpose of this exercise is to use the skills presented in this chapter to analyze hypothetical population trends for a fashion retailer.

1. In the Sheet1 worksheet, enter the year 2023 into cellB3.
2. Use Auto fill to fill the years 2019 to 2022 in the rangeC3:F3.
3. Change the font style to Arial and the font size to 12 points for all cell locations in the Sheet1 worksheet.
4. Merge and center the cells in the range A1:F1.
5. Make the following formatting adjustments to the range A1:F1: bold; italics; change the cell fill color to Olive Green, Accent 3, Lighter 60%; change the font size to 14 points.
6. Enter the title for this worksheet into the range A1:F1 on two lines. The first line should read **Population Trends by Age Group**. The second line should read **for Region 5**.
7. Increase the height of Row 1 so the title is visible.
8. Delete Row 2.
9. Increase the height of Row 2 to 21 points.
10. Format the values in the range B3:F6 so a comma separates each thousands place with zero decimal places.
11. Make the necessary adjustments to remove any pound signs (####) that may have appeared after formatting the values.
12. Sort the data in the range A2:F6 based on the values in the year 2018 from largest to smallest.
13. Enter the word **Totals** in cell A7.
14. Increase the height of Row 7 to 22.50 points.
15. Format the range A7:F7 so entries are bold and italic.
16. In cell B7, add a total that sums the values in the range B3:B6. Format the value with zero decimal places and a comma for each thousands place.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

17. Copy the contents of cell B7 and paste them into the range C7:F7.
18. Add vertical and horizontal lines to the range A1:F7.
19. Add a very bold orange border around the perimeter of the rangeA1:F7.
20. Insert a column chart using the data in the range A2:F6. Select the 2-D Stacked Column format.
21. Move the column chart so the upper left corner is in the middle of cell A8.
22. Rename the Sheet1 worksheet tab to Population Trends.
23. Adjust the appropriate settings so the Population Trends worksheet prints on one piece of paper.
24. Add a header to the Population Trends worksheet that shows the date in the upper left corner and your name in the center. Save the workbook by adding your name in front of the current workbook name (i.e., "*your name* Chapter 1 CiP Exercise 2"). (Hint: you will need to Save As.)



Integrity Check

Starter File : Chapter 1 IC Exercise 1

Difficulty: Level 3

The purpose of this exercise is to analyze a worksheet to determine whether there are any integrity flaws. First, read the scenario below. Then, open the file that is related to this exercise and analyze the worksheets contained in the workbook. You will find a worksheet

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

in the workbook named Answer Sheet. This worksheet is to be used for any written responses required for this exercise.

Scenario:

Your coworker provides you with sales data in an Excel workbook, which you intend to use for a sales strategy meeting with your boss. The workbook was attached to an e-mail with the following points stated in the message.

- The data represents the top-selling items for the company last year with respect to sales dollars.
- I received the data from an analyst in my department who insisted the cost data for each item was included. However, I don't see it. You might have to manually enter this yourself. I include the cost for each item below.
- The original data I received is in Sheet1. I copied this data and pasted it into Sheet2. I thought you might like to see this sorted.

Cost per Item Data:	**Cost**
Black Flat	$35.00
Bracelet	$30.00
Brown Pump	$25.00
Daisy Print	$40.00
Grey Stripe	$110.00
Jersey Knit	$80.00
Navy Pinstripe	$125.00
Navy Wool	$135.00
Quartz Watch	$80.00
Sandal	$45.00
Tan Trench	$115.00
Topaz Ring	$50.00

Assignment

1. Analyze the data in this workbook carefully. Would you be comfortable using this data in a meeting with your boss? Use the Answer Sheet in this workbook to briefly list any concerns you have with this data.
2. If it is necessary to enter the cost information, enter it in the Sheet1 worksheet. If not, state why in the Answer Sheet.
3. Correct any problems and make any adjustments you think are appropriate to this workbook.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

4. Save the workbook by adding your name in front of the current workbook name.

Applying Excel Skills

The assignment in this section requires that you apply the skills presented in this chapter to achieve the stated objective. Read the assignment first and then open the file and complete the stated requirements. When you complete an assignment, save the file by adding your name in front of the current name of the workbook.

Starter File: Chapter 1 AES Assignment 1
Difficulty: Level 3

The workbook for this assignment contains sales plan data by month for merchandise categories sold by a hypothetical clothing retailer. Use the skills covered in this chapter to accomplish the points listed below.

1. Show the total sales plan dollars next to each category in Column B.

2. In addition to showing the sales plan dollars by month, calculate the plan dollars for each quarter (see the following figure, "Layout for Sales by Quarter"). The months assigned to each quarter are as follows:

- Quarter 1: February, March, and April
- Quarter 2: May, June, and July
- Quarter 3: August, September, and October
- Quarter 4: November, December, and January

3. Show the total plan for each quarter.

4. Sort the merchandise categories based on the total sales plan dollars.

5. Add any additional formatting enhancements that will make the worksheet easier to read.

Figure 1.68 Layout for Sales by Quarter

Category	Total Sales Plan	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Shoes					
Casual Pants					
Casual Shirts					
Dress Shirts					
Dress Pants					
Suits					
Accessories					

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Chapter 1 Fundamental Skills Test

Starter File: Chapter 1 Skills Test
Difficulty: Level 2

Complete the following steps by executing the skills in the starter file required for this test. Complete each step in the order in which it appears. If you do not know how to complete a step, skip to the next step. Open the starter file before you begin this test.

1. In the Sheet1 worksheet, enter the word Totals in cell C14.
2. Format all the cells in Sheet1 to Arial font style and a 12-point font size. Change the Theme to Facet.
3. Set the character width for Columns A through G to 12.71.
4. Edit the entry in cell B2 to read "Item Number."
5. Use Auto fill to fill the contents of cell B3 into the range B4:B13.
6. Copy the contents of cell A3 and paste them into the range A4:A8.
7. Delete Column F.
8. Format the range A1:F2 so the text is Bold.
9. Set the alignment in the range A2:F2 to Wrap Text.
10. Change the fill color of the cells in the range A1:F1 to any red color fill.
11. Make the following font changes to the range A1:F1: set the font color to white, add italics, and set the font size to 14.
12. Merge and center the cells in the range A1:F1.
13. Enter the title for this worksheet in the range A1:F1. The title should appear on three lines. The first line should read Status Report. The second line should read Sales and Inventory by Item. The third line should read: For Spring and Fall 2024.
14. Increase the height of Row 1 so the entire title is visible.
15. Insert a blank row above Row 14.
16. In cells E15 and F15, use AutoSum to calculate the sums of Sales in Units and Inventory in Units.
17. Add vertical and horizontal lines to the range A1:F15.
18. Add a bold line border around the perimeter of the range A1:F15.
19. Insert a column chart using the data in the range D2:E13.
20. Move the chart so the upper left corner is in the middle of cell H2.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

21. Sort the data in the range A2:F13 based on the values in the Sales in Units column. Sort the values in descending order or largest to smallest.
22. Format the values in the cell C3 with a US dollar sign and two decimal places. Format the cells in the range C4:C13 with comma and 2 decimal places.
23. Format the values in the range E3:F13 and E15:F15 with zero decimal places and a comma at each thousands place.
24. Insert a new blank worksheet in the workbook.
25. Delete Sheet3.
26. Move Sheet4 ahead of Sheet2 so the order of the worksheets is Sheet1, Sheet4, and Sheet2.
27. Rename the Sheet1 worksheet tab to "Status Report."
28. Change the orientation of the Status Report worksheet so it prints landscape instead of portrait.
29. Adjust the appropriate settings so the Status Report worksheet prints on one piece of paper.
30. Add a header to the Status Report worksheet that shows the date in the upper left corner and your name in the center.
31. Add a footer to the Status Report worksheet that shows the page number in the lower right corner.
32. Save the workbook. Close the workbook and Excel.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Chapter 2

Mathematical Computations

Perhaps the most valuable feature of Excel is its ability to produce mathematical outputs using the data in a workbook. This chapter reviews several mathematical outputs that you can produce in Excel through the construction of formulas and functions. The chapter begins with the construction of formulas for basic and complex mathematical computations. The second section reviews statistical functions, such as SUM, AVERAGE, MIN, and MAX, which can be applied to a range of cells. The last section of the chapter addresses functions used to calculate mortgage and lease payments as well as the valuation of investments. This chapter also shows how you can use data from multiple worksheets to construct formulas and functions. These skills will be demonstrated in the context of a personal cash budget, which is a vital tool for managing your money for long-term financial security. The personal budget objective will also provide you with several opportunities to demonstrate Excel's what-if scenario capabilities, which highlight how formulas and functions automatically produce new outputs when one or more inputs are changed.

2.1 Formulas

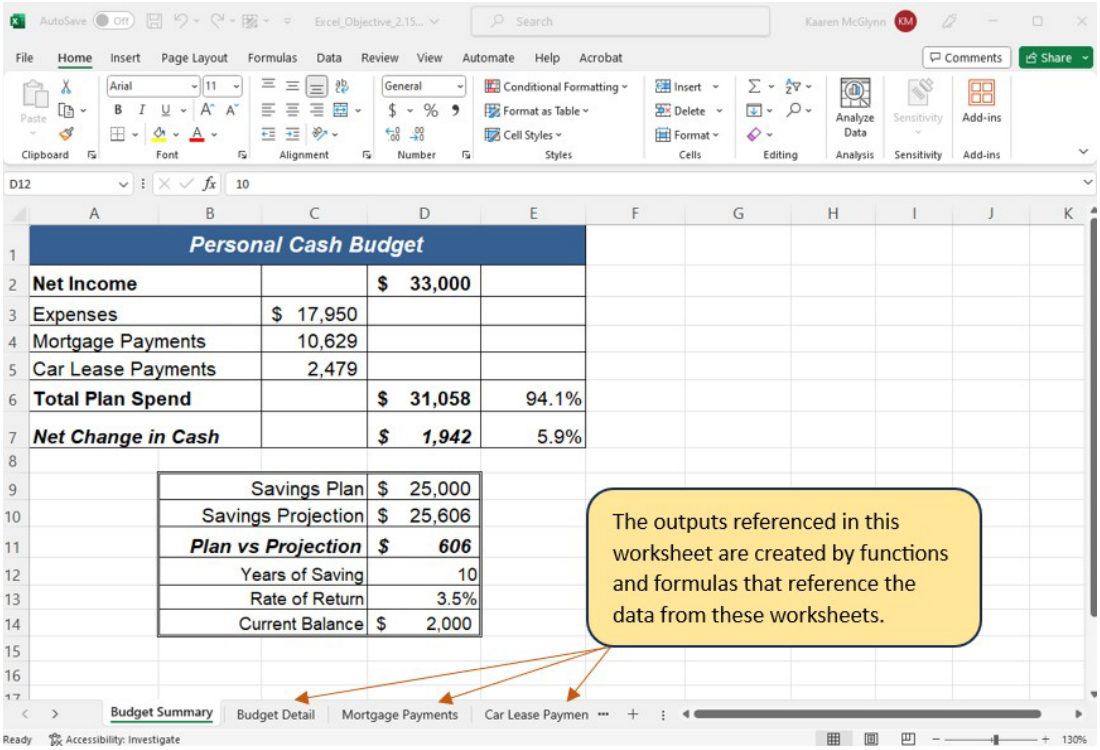
LEARNING OBJECTIVES
1. Learn how to create basic formulas.
2. Understand relative referencing when copying and pasting formulas.
3. Work with complex formulas by controlling the order of mathematical operations.

This section reviews the fundamental skills for entering formulas into an Excel worksheet. The objective used for this chapter is the construction of a personal cash budget. Most financial advisors recommend that all households construct and maintain a personal budget to achieve and maintain strong financial health. Organizing and maintaining a personal budget is a skill you can practice at any point in your life. Whether you are managing your expenses during college or maintaining the finances of a family of four, a personal budget can be a vital tool when making financial decisions. Excel can make managing your money a fun and rewarding exercise.

Figure 2.1 "Completed Personal Cash Budget Workbook" shows the completed workbook that will be demonstrated in this chapter. Notice that this workbook contains four worksheets. The first worksheet, **Budget Summary**, contains formulas that utilize or reference the data in the other three worksheets. As a result, the **Budget Summary** worksheet serves as an overview of the data that was entered and calculated in the other three worksheets of the workbook.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.1 Completed Personal Cash Budget Workbook


Personal Cash Budget
Net Income $ 33,000
Expenses $ 17,950
Mortgage Payments 10,629
Car Lease Payments 2,479
Total Plan Spend $ 31,058 94.1%
Net Change in Cash $ 1,942 5.9%
Savings Plan $ 25,000
Savings Projection $ 25,606
Plan vs Projection $ 606
Years of Saving 10
Rate of Return 3.5%
Current Balance $ 2,000
The outputs referenced in this worksheet are created by functions and formulas that reference the data from these worksheets.
Budget Summary
Budget Detail
Mortgage Payments
Car Lease Paymen

Creating a Basic Formula

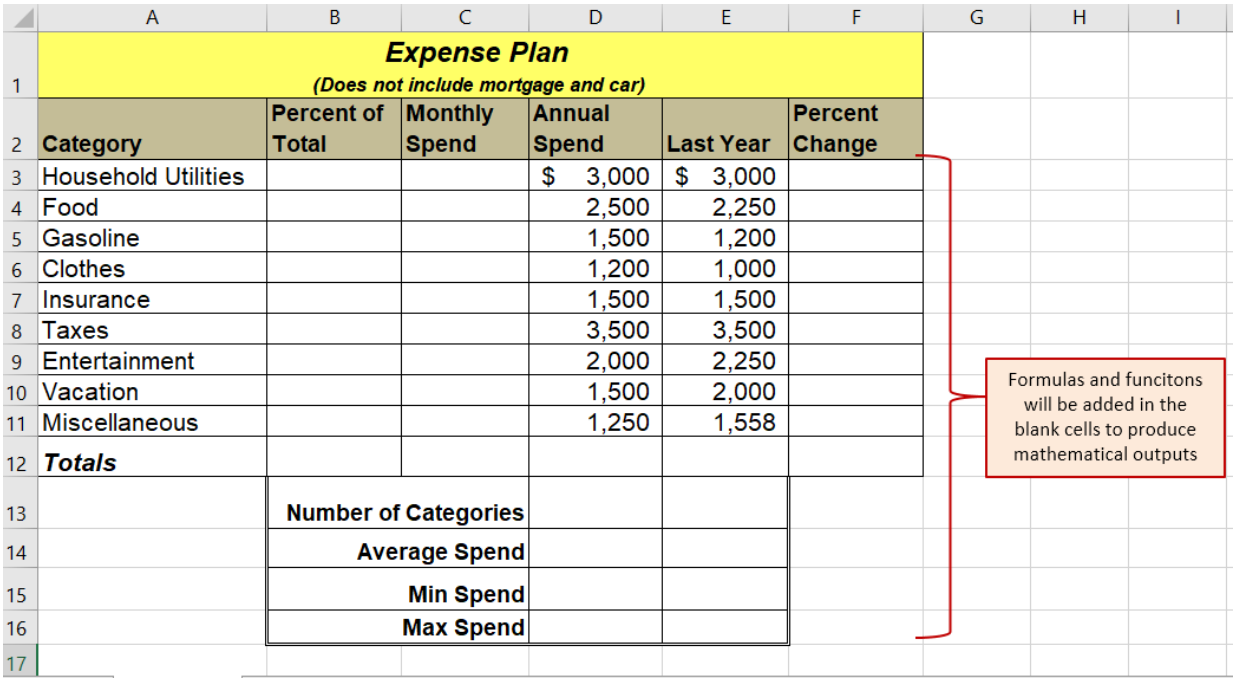
Follow-along file: Excel Objective 2.00

Formulas are used to calculate a variety of mathematical outputs in Excel and can be used to create virtually any custom calculation required for your objective. Furthermore, when constructing a formula in Excel, you use cell locations that, when added to a formula, become cell references. This means that Excel uses, or references, the number entered into the cell location when calculating a mathematical output. As a result, when the numbers in the cell references are changed, Excel automatically produces a new output. This is what gives Excel the ability to create a variety of what-if scenarios, which will be explained later in the chapter.

To demonstrate the construction of a basic formula, we will begin working on the **Budget Detail** worksheet in the Personal Budget workbook, which is shown in Figure 2.2 "Budget Detail Worksheet". To complete this worksheet, we will add several formulas and functions. Table 2.1 "Spend Category Definitions" provides definitions for each of the spend categories listed in the range A3:A11. When you develop a personal budget, these categories are defined based on how you spend your money. It is likely that every person could have different categories or define the same categories differently. Therefore, it is important to review the definitions in Table 2.1 "Spend Category Definitions" to understand how we are defining these categories before proceeding.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.2 Budget Detail Worksheet



	A	B	C	D	E	F	G	H	I
1	**Expense Plan** *(Does not include mortgage and car)*								
2	**Category**	**Percent of Total**	**Monthly Spend**	**Annual Spend**	**Last Year**	**Percent Change**			
3	Household Utilities			$ 3,000	$ 3,000				
4	Food			2,500	2,250				
5	Gasoline			1,500	1,200				
6	Clothes			1,200	1,000				
7	Insurance			1,500	1,500				
8	Taxes			3,500	3,500				
9	Entertainment			2,000	2,250				
10	Vacation			1,500	2,000				
11	Miscellaneous			1,250	1,558				
12	***Totals***								
13		**Number of Categories**							
14		**Average Spend**							
15		**Min Spend**							
16		**Max Spend**							
17									

Table 2.1 Spend Category Definitions

Category	Definition
Utilities	Money spent on electricity, heat, and water and on cable, phone, and Internet access
Food	Money spent on groceries, toiletries, and related items
Gasoline	Money spent on fuel for automobiles
Clothes	Money spent on clothes, shoes, and accessories
Insurance	Money spent on homeowner's or automobile insurance
Taxes	Money spent on school and property taxes (this example of the personal budget assumes that we own property).
Entertainment	Money spent on entertainment, including dining out, movie and theater tickets, parties, and so on
Vacation	Money spent on vacations
Miscellaneous	Includes any other spending categories, such as textbooks, software, journals, school or work supplies, and so on

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

The first formula that we will add to the **Budget Detail** worksheet will calculate the Monthly Spend values. The formula will be constructed so that it takes the values in the Annual Spend column and divides them by 12. This will show how much money will be spent per month for each of the categories listed in Column A. The following explains how this formula is created:

1. Click the **Budget Detail** worksheet tab to open the worksheet.
2. Click cell C3.
3. Type an equal sign (**=**). When the first character entered into a cell location is an equal sign, it signals Excel to perform a calculation or produce a logical output.
4. Click on cell **D3**. This adds D3 to the formula, which is now a cell reference. Excel will use whatever value is entered into cell D3 to produce an output.
5. Type the slash symbol (**/**). This is the symbol for division in Excel. As shown in Table 2.2 "Excel Mathematical Operators", the mathematical operators in Excel are slightly different from those found on a typical calculator.
6. Type the number **12**. This divides the value in cell D3 by 12. In this formula, a number, or constant, is used instead of a cell reference because it will not change. In other words, there will always be 12 months in a year.
7. Press the ENTER key.

Table 2.2 Excel Mathematical Operators

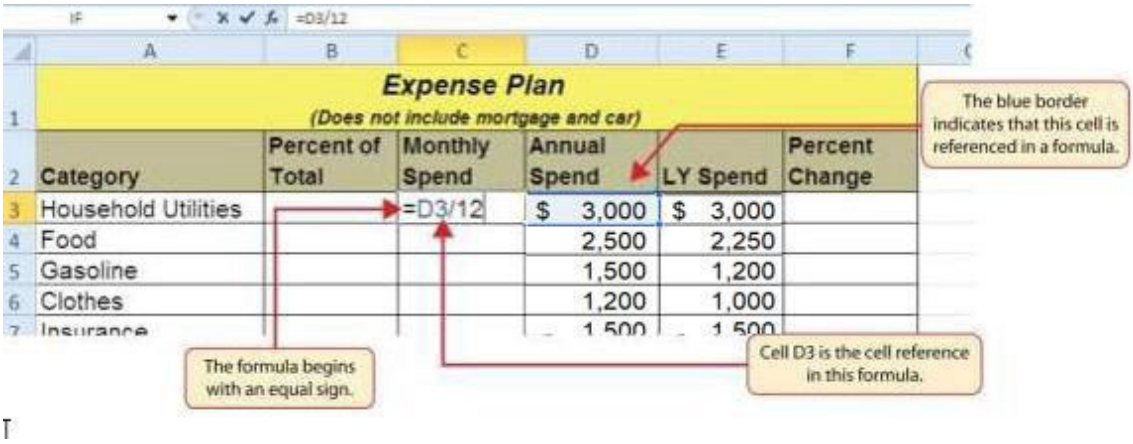
Symbo	**Operation**
+	Addition
–	Subtraction
/	Division
*****	Multiplication
^	Power/Expon

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Why?
Use Cell References Cell references enable Excel to dynamically produce new outputs when one or more inputs in the referenced cells are changed. Cell references also allow you to trace how outputs are being calculated in a formula. As a result, **you should never use a calculator to determine a mathematical output and type it into the cell location of a worksheet**. Doing so eliminates Excel's cell-referencing benefits as well as your ability to trace a formula to determine how outputs are being produced.

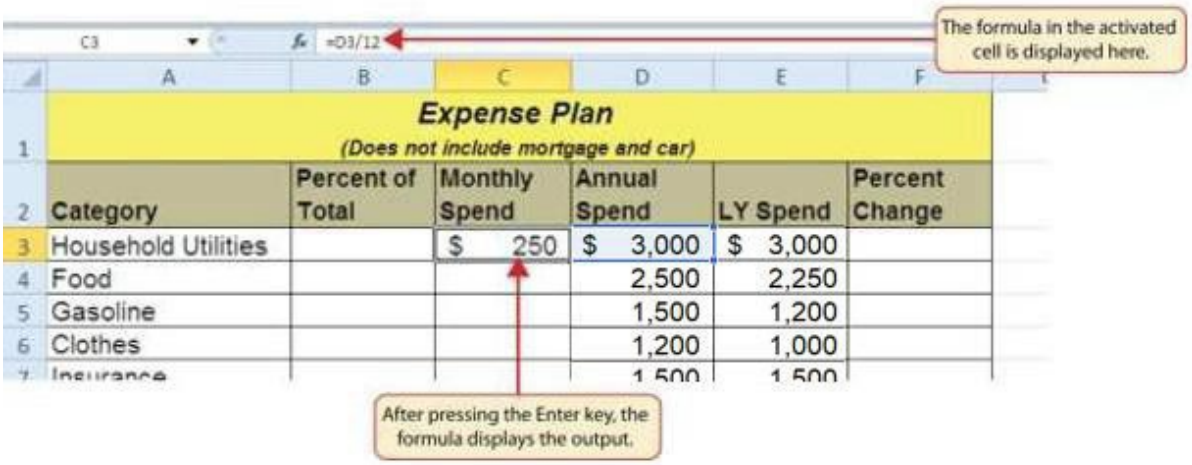
Figure 2.3 "Adding a Formula to a Worksheet" shows how the formula appears in cell C3 before you press the ENTER key. Figure 2.4 "Formula Output for Monthly Spend" shows the output of the formula after you press the ENTER key. The monthly spend for Household Utilities is $250 because the formula is taking the Annual Spend in cell D3 and dividing it by 12. If the value in cell D3 is changed, the formula automatically produces a new output. We are calculating the spend per month for each category because people often get paid and are billed for these items monthly. This formula allows you to compare your monthly income to your monthly bills to determine whether you have enough income to pay these expenses.

Figure 2.3 Adding a Formula to a Worksheet



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.4 Formula Output for Monthly Spend



Why?
Use Universal Constants If you are using constants, or numerical values, in an Excel formula, they should be universal constants that do not change, such as the number of days in a week, weeks in a year, and so on. **Do not type the values that exist in cell locations into an Excel formula**. This will eliminate Excel's cell- referencing benefits, which means if the value in the cell location you are using in a formula is changed, Excel will not be able to produce a new output.

Relative References (Copying and Pasting Formulas)

Follow-along file: Continue with Excel Objective 2.00. (Use file Excel Objective 2.01 if starting here.)

Once a formula is typed into a worksheet, it can be copied and pasted to other cell locations. For example, Figure 2.4 "Formula Output for Monthly Spend" shows the output of the formula that was entered into cell C3. However, this calculation needs to be performed for the rest of the cell locations in Column C. Since we used the D3 cell reference in the formula, Excel automatically adjusts that cell reference when the formula is copied and pasted into the rest of the cell locations in the column. This is called relative referencing and is demonstrated as follows:

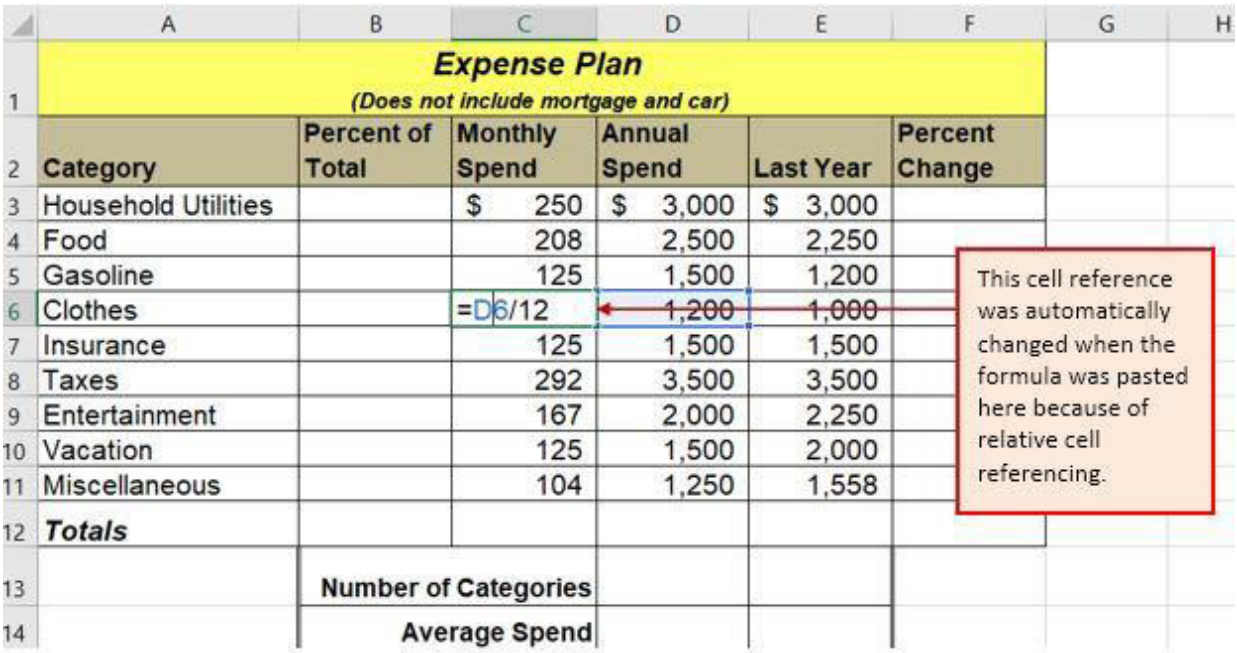
1. Click cell C3.
2. Click the Copy button in the Home tab of the Ribbon.
3. Highlight the range C4:C11.
4. Click the Paste button in the Home tab of the Ribbon. (or hit Enter)

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

5. While the cells are still highlighted, format cells C4:C11 for comma with no decimal places.
6. Double click cell C6. Notice that the cell reference in the formula automatically changed to D6 when copied.
7. Press the ENTER key.

Figure 2.5 "Relative Reference Example" shows the outputs added to the rest of the cell locations in the Monthly Spend column. For each row, the formula takes the value in the Annual Spend column and divides it by 12. You will also see that cell D6 has been double clicked to show the formula. Notice that Excel automatically changed the original cell reference of D3 to D6. This is the result of relative referencing, which means Excel automatically adjusts a cell reference relative to its original location when it is pasted into new cell locations. In this example, the formula was pasted into eight cell locations below the original cell location. As a result, Excel increased the row number of the original cell reference by a value of one for each row it was pasted into.

Figure 2.5 Relative Reference Example


Expense Plan
(Does not include mortgage and car)
Category
Percent of Total
Monthly Spend
Annual Spend
Last Year
Percent Change
Household Utilities $ 250 $ 3,000 $ 3,000
Food 208 2,500 2,250
Gasoline 125 1,500 1,200
Clothes =D6/12 1,200 1,000
Insurance 125 1,500 1,500
Taxes 292 3,500 3,500
Entertainment 167 2,000 2,250
Vacation 125 1,500 2,000
Miscellaneous 104 1,250 1,558
Totals
Number of Categories
Average Spend
This cell reference was automatically changed when the formula was pasted here because of relative cell referencing.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Why?
Use Relative Referencing Relative referencing is a convenient feature in Excel. When you use cell references in a formula, Excel automatically adjusts the cell references when the formula is pasted into new cell locations. If this feature were not available, you would have to manually retype the formula when you want the same calculation applied to other cell locations in a column or row.

Creating Complex Formulas (Controlling the Order of Operations)

Follow-along file: Continue with Excel Objective 2.00. (Use file Excel Objective 2.02 if starting here.)

The next formula to be added to the Personal Budget workbook is the percent change in spending this year over last year. This formula determines the difference between the values in the LY (Last Year) Spend column and shows the difference in terms of a percentage. This requires that the order of mathematical operations be controlled to get an accurate result. Table 2.3 "Standard Order of Mathematical Operations" shows the standard order of operations for a typical formula.

Table 2.3 Standard Order of Mathematical Operations

Symbol	Order
^	*First:* Excel executes all exponential computations first.
*** or /**	*Second:* Excel performs multiplication or division computations second. When there are multiple instances of these computations in a formula, they are executed in order from left to right.
+ or –	*Third:* Excel performs addition or subtraction computations third. When there are multiple instances of these computations in a formula, they are executed in order from left to right.
( )	*Override Standard Order: M*athematical computations placed in parentheses are performed first and override the standard order of operations. If there are layers of parentheses used in a formula, Excel computes the innermost parentheses first and the outermost parentheses last.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

To change the order of operations shown in the table, we use parentheses to process certain mathematical calculations first. This formula is added to the worksheet as follows:

1. Click cell F3 in the **Budget Detail** worksheet.
2. Type an equal sign (**=**).
3. Type an open parenthesis (**(**).
4. Click cell D3. This will add a cell reference to cell D3 to the formula. When building formulas, you can click cell locations instead of typing them.
5. Type a minus sign (**–**).
6. Click cell E3 to add this cell reference to the formula.
7. Type a closing parenthesis **)**.
8. Type the slash (**/**) symbol for division.
9. Click cell E3. This completes the formula that will calculate the percent change of last year's actual spent dollars vs. this year's budgeted spend dollars (see Figure 2.6 "Adding the Percent Change Formula").
10. Press the ENTER key.
11. Click cell F3 to activate it.
12. Place the mouse pointer over the Auto Fill Handle in the lower right corner of the cell.
13. When the mouse pointer turns from a white block plus sign to a narrow black plus sign, click and drag down to cell F11. This pastes the formula into the range F4:F11.

Figure 2.6 "Adding the Percent Change Formula" shows the formula that was added to the **Budget Detail** worksheet to calculate the percent change in spending. Parentheses were added to this formula to control the order of operations. Any mathematical computations placed in parentheses are executed first before the standard order of mathematical operations (see Table 2.3 "Standard Order of Mathematical Operations"). In this case, if parentheses were not used, Excel would produce an erroneous result for this worksheet.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.6 Adding the Percent Change Formula

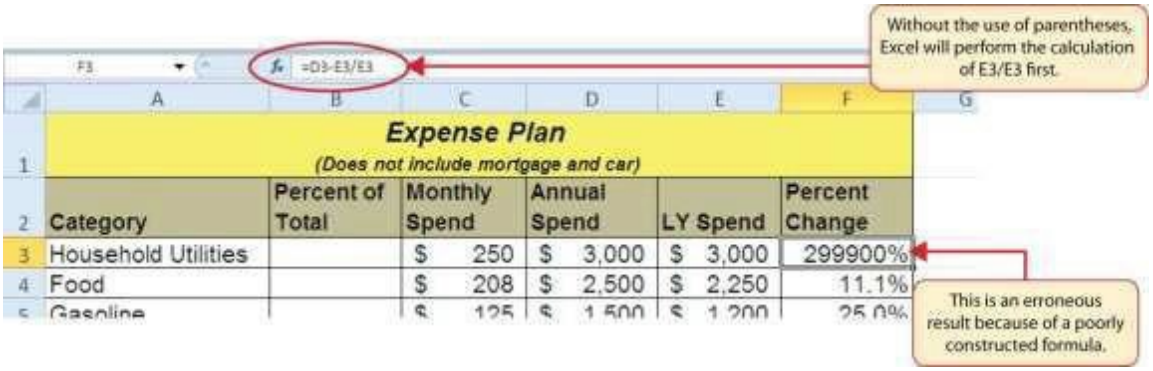
	A	B	C	D	E	F	G	H	I
1	**Expense Plan** (Does not include mortgage and car)								
2	**Category**	**Percent of Total**	**Monthly Spend**	**Annual Spend**	**Last Year**	**Percent Change**			
3	Household Utilities		$ 250	$ 3,000	$ 3,000	0.0%			
4	Food		208	2,500	2,250	11.1%			
5	Gasoline		125	1,500	1,200	25.0%			
6	Clothes		100	1,200	1,000	20.0%			
7	Insurance		125	1,500	1,500	0.0%			
8	Taxes		292	3,500	3,500	0.0%			
9	Entertainment		167	2,000	2,250	-11.1%			
10	Vacation		125	1,500	2,000	-25.0%			
11	Miscellaneous		104	1,250	1,558	-19.8%			
12	***Totals***								
13		**Number of Categories**							

Mathematical computations in parenthesis are peformed first

Figure 2.7 "Removing the Parentheses from the Percent Change Formula" shows the result of the percent change formula if the parentheses are removed. The formula produces a result of a 299900% increase. Since there is no change between the LY spend and the budget Annual Spend, the result should be 0%.

However, without the parentheses, Excel is following the standard order of operations. This means the value in cell E3 will be divided by E3 first (3,000/3,000), which is 1. Then, the value of 1 will be subtracted from the value in cell D3 (3,000−1), which is 2,999. Since cell F3 is formatted as a percentage, Excel expresses the output as an increase of 299900%.

Figure 2.7 Removing the Parentheses from the Percent Change Formula



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Auditing Formulas

Follow-along file: Continue with Excel Objective 2.00. (Use file Excel Objective 2.03 if starting here.)

Excel provides a few tools that you can use to review the formulas entered into a worksheet. For example, instead of showing the outputs for the formulas used in a worksheet, you can have Excel show the formula as it was entered in the cell locations. This is demonstrated as follows:

1. With the **Budget Detail** worksheet open, click the Formulas tab of the Ribbon.
2. Click the Show Formulas button in the Formula Auditing group of commands. This displays the formulas in the worksheet instead of showing the mathematical outputs.
3. Click the Show Formulas button again. The worksheet returns to showing the output of the formulas.

Integrity Check

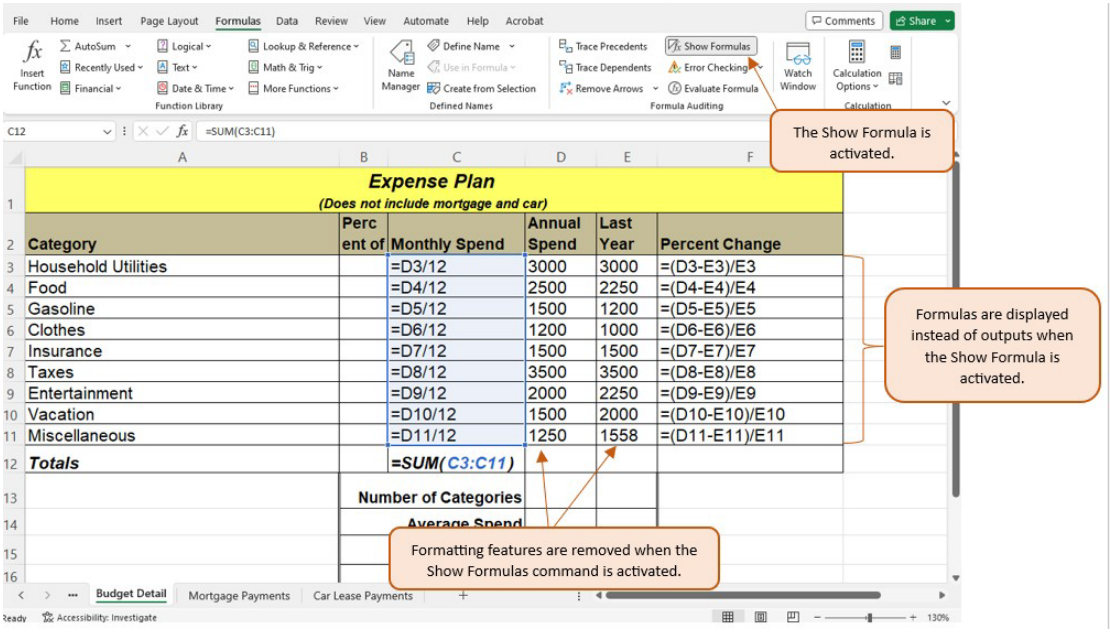
Does the Output of Your Formula Make Sense?

It is important to note that the accuracy of the output produced by a formula depends on how it is constructed. Therefore, always check the result of your formula to see whether it makes sense with data in your worksheet. As shown in Figure 2.7 "Removing the Parentheses from the Percent Change Formula", a poorly constructed formula can give you an inaccurate result. In other words, you can see that there is no change between the Annual Spend and LY Spend for Household Utilities. Therefore, the result of the formula should be 0%. However, since the parentheses were removed in this case, the formula is clearly producing an erroneous result.

Figure 2.8 "Show Formulas Command" shows the **Budget Detail** worksheet after activating the Show Values command in the Formulas tab of the Ribbon. As shown in the figure, this command allows you to view and check all the formulas in a worksheet without having to click each cell individually. After activating this command, the column widths in your worksheet increase significantly. The column widths were adjusted for the worksheet shown in Figure 2.8 "Show Formulas Command" so all columns can be seen. The column widths return to their previous width when the Show Formulas command is deactivated.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.8 Show Formulas Command


The Show Formula is activated.
Formulas are displayed instead of outputs when the Show Formula is activated.
Formatting features are removed when the Show Formulas command is activated.
Expense Plan
(Does not include mortgage and car)
Category
Percent of
Monthly Spend
Annual Spend
Last Year
Percent Change
Household Utilities =D3/12 3000 3000 =(D3-E3)/E3
Food =D4/12 2500 2250 =(D4-E4)/E4
Gasoline =D5/12 1500 1200 =(D5-E5)/E5
Clothes =D6/12 1200 1000 =(D6-E6)/E6
Insurance =D7/12 1500 1500 =(D7-E7)/E7
Taxes =D8/12 3500 3500 =(D8-E8)/E8
Entertainment =D9/12 2000 2250 =(D9-E9)/E9
Vacation =D10/12 1500 2000 =(D10-E10)/E10
Miscellaneous =D11/12 1250 1558 =(D11-E11)/E11
Totals =SUM(C3:C11)
Number of Categories
Average Spend
Budget Detail
Mortgage Payments
Car Lease Payments

Keyboard Shortcuts – Show Formulas

- Hold down the CTRL key while pressing the accent symbol(`). (Above the tab key on the left-hand side.)

Two other tools in the Formula Auditing group of commands are the Trace Precedents and Trace Dependents commands. These commands are used to trace the cell references used in a formula. The Trace Dependents command shows where any given cell is referenced in a formula. The Trace Precedents command shows what cells have been referenced in a formula that exists in an activated cell. The following is a demonstration of these commands:

1. Click cell D3 in the **Budget Detail** worksheet.
2. Click the Trace Dependents button in the Formula Auditing group of commands in the Formulas tab of the Ribbon. A double blue arrow appears, pointing to cell locations C3 and F3 (see Figure 2.9"Trace Dependents Example"). This indicates that cell D3 is referenced in formulas that are entered in cells C3 and F3.
3. Click the Remove Arrows command in the Formula Auditing group of commands in the Formulas tab of the Ribbon. This removes the Trace Dependents arrow.
4. Click cell F3 in the **Budget Detail** worksheet.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

5. Click the Trace Precedents button in the Formula Auditing group of commands in the Formulas tab of the Ribbon. A blue arrow running through cells D3 and E3 and pointing to cell F3 appears (see Figure 2.10 "Trace Precedents Example"). This indicates that cells D3 and E3 are references in a formula entered in cell F3.
6. Click the Remove Arrows command in the Formula Auditing group of commands in the Formulas tab of the Ribbon. This removes the Trace Precedents arrow.

Figure 2.9 "Trace Dependents Example" shows the Trace Dependents arrow on the **Budget Detail** worksheet. The blue dot represents the activated cell. The arrows indicate where the cell is referenced in formulas.

Figure 2.9 Trace Dependents Example

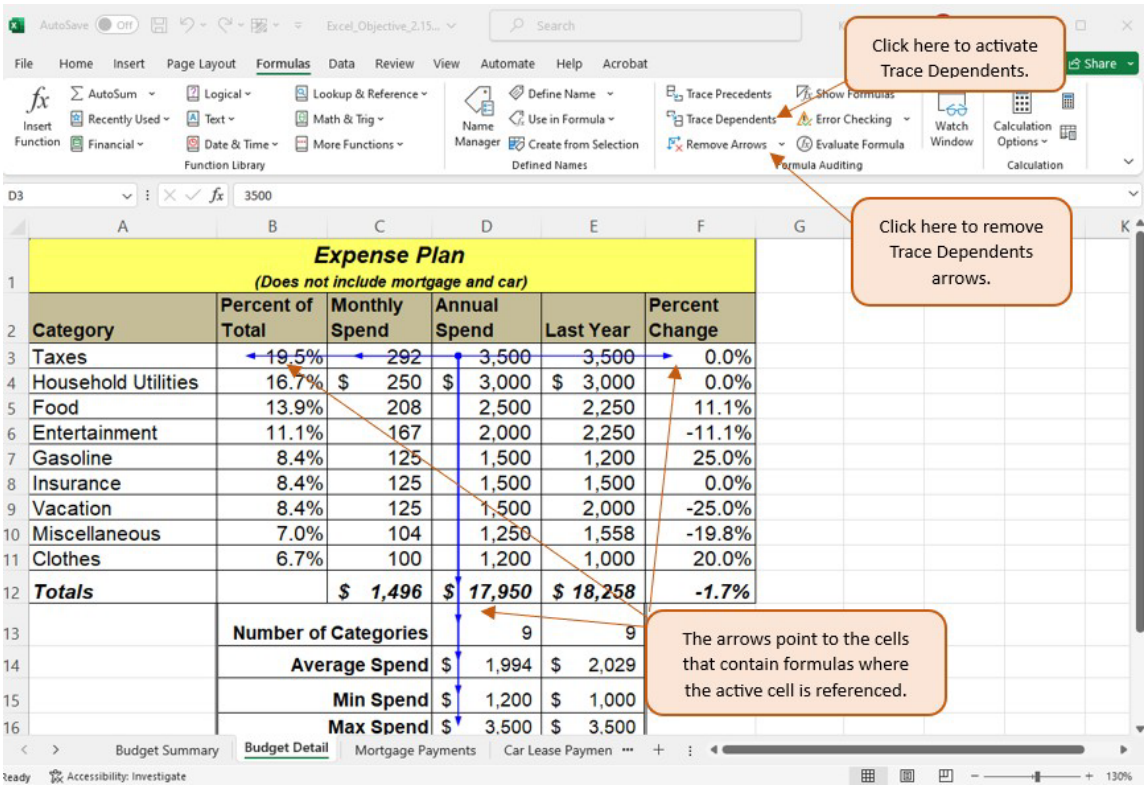
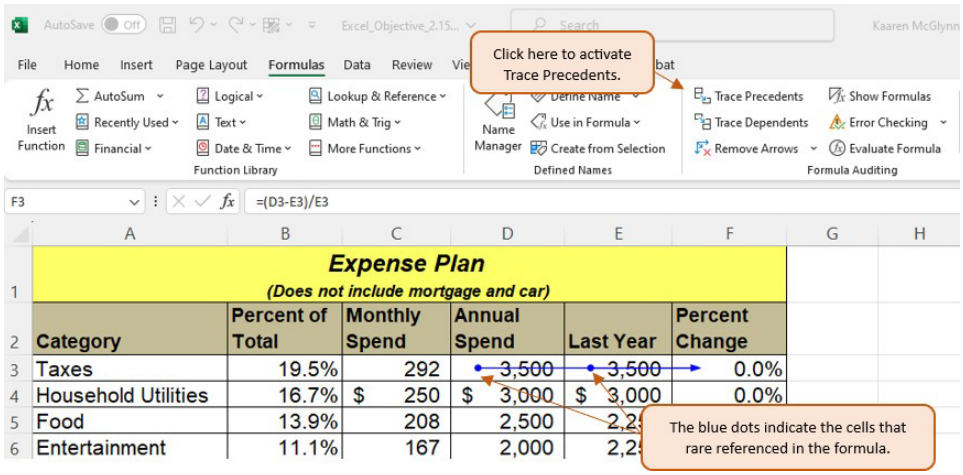

Click here to activate Trace Dependents.
Click here to remove Trace Dependents arrows.
The arrows point to the cells that contain formulas where the active cell is referenced.
Expense Plan
(Does not include mortgage and car)
Category
Percent of Total
Monthly Spend
Annual Spend
Last Year
Percent Change
Taxes 19.5% 292 3,500 3,500 0.0%
Household Utilities 16.7% $ 250 $ 3,000 $ 3,000 0.0%
Food 13.9% 208 2,500 2,250 11.1%
Entertainment 11.1% 167 2,000 2,250 -11.1%
Gasoline 8.4% 125 1,500 1,200 25.0%
Insurance 8.4% 125 1,500 1,500 0.0%
Vacation 8.4% 125 1,500 2,000 -25.0%
Miscellaneous 7.0% 104 1,250 1,558 -19.8%
Clothes 6.7% 100 1,200 1,000 20.0%
Totals $ 1,496 $ 17,950 $ 18,258 -1.7%
Number of Categories 9 9
Average Spend $ 1,994 $ 2,029
Min Spend $ 1,200 $ 1,000
Max Spend $ 3,500 $ 3,500
Budget Summary
Budget Detail
Mortgage Payments
Car Lease Paymen

Figure 2.10 "Trace Precedents Example" shows the Trace Precedents arrow on the **Budget Detail** worksheet. The blue dots on this arrow indicate the cells that are referenced in the formula contained in the activated cell. The arrow is pointing to the activated cell location that contains the formula.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.10 Trace Precedents Example



Skill Refresher – Trace Dependents

1. Click a cell location that contains a number or formula.
2. Click the Formulas tab on the Ribbon.
3. Click the Trace Dependents button in the Formula Auditing group of commands.
4. Use the arrow(s) to determine where the cell is referenced in formulas and functions.
5. Click the Remove Arrows button to remove the arrows from the worksheet.

Skill Refresher – Trace Precedents

1. Click a cell location that contains a formula or function.
2. Click the Formulas tab on the Ribbon.
3. Click the Trace Precedents button in the Formula Auditing group ofcommands.
4. Use the dot(s) along the line to determine what cells are referenced in the formula or function.
5. Click the Remove Arrows button to remove the line with the dots.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Key Takeaways

- Mathematical computations are conducted through formulas and functions.
- An equal sign (=) precedes all formulas and functions.
- Formulas and functions must be created with cell references to conduct what-if scenarios where mathematical outputs are recalculated when one or more inputs are changed.
- Mathematical operators on a typical calculator are different from those used in Excel. Table 2.2 "Excel Mathematical Operators" lists Excel mathematical operators.
- When using numerical values in formulas and functions, only use universal constants that do not change, such as days in a week, months in a year, and so on.
- Relative referencing automatically adjusts the cell references in formulas and functions when they are pasted into new locations on a worksheet. This eliminates the need to retype formulas and functions when they are needed in multiple rows or columns on a worksheet.
- Parentheses must be used to control the order of operations when necessary for complex formulas.
- Formula auditing tools such as Trace Dependents, Trace Precedents, and Show Formulas should be used to check the integrity of formulas that have been entered into a worksheet

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

EXERCISES

1. Which of the following terms best describes how Excel can change the outputs of formulas and functions when one or more inputs are changed?
   a. absolute references
   b. cell references
   c. relative references
   d. dynamic output referencing
2. Which of the following best describes the proper use of numbers when constructing formulas in Excel?
   a. Numbers cannot be used in the construction of formulas. You can use only cell locations.
   b. You cannot combine numbers and cell locations in a formula. This will produce an error.
   c. Numbers should always be used when creating formulas in Excel.
   d. Numbers should be used when constructing formulas with constants that do not change, such as the days in a week, months in a year, and soon.
3. Which of the following will be calculated first in the formula =((C10−D2) *A9) +B5*C5?
   a. D2*A9
   b. B5*C5
   c. C10−D2
   d. A9 * the result of (C10−D2)
4. Which of the following formula auditing features would you use if you wanted to see where a specific cell location was referenced in formulas entered into a worksheet?
   a. Show Formulas
   b. Trace Precedents
   c. Trace Dependents
   d. Show Cell Reference Mapping

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

2.2 Dynamic Arrays

Dynamic arrays were introduced in Microsoft Excel 365. They are resizable arrays that calculate automatically and return values into multiple cells based on a formula entered in a single cell. This action is called Spilling and denotes the ability of the array to go outside the bounds of the cell.

LEARNING OBJECTIVES
1. Learn about vertical and horizontal arrays.
2. Understand two-dimensional arrays.
3. Understand dynamic array formulas and compatibility.

Whenever you include a range argument in an Excel function or formula you are providing the function with an array Arrays can contain different data types such as numbers, text and TRUE/FALSE logical values. Arrays cannot contain parentheses, currency prefixes, or percent symbols and cannot be used in complex nested functions.

One-Dimensional Arrays

A one-dimensional array can be either horizonal (rows) or vertical (columns) but would not include both. Let's examine a simple worksheet.

	A	B	C	D	E	F
1			**Sales in Units:**			
2		**Apparel**	**Jan**	**Feb**	**Mar**	**Total**
3		Hats	15	12	17	**44**
4		Shoes	5	8	2	**15**
5		Shirts	12	20	15	**47**
6		**Total**	**32**	**40**	**34**	

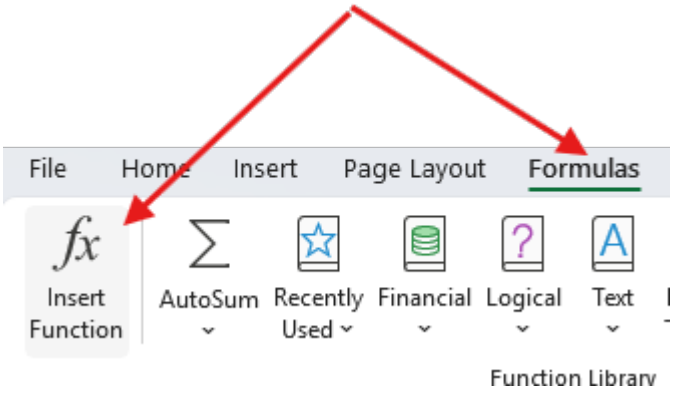
These are the cells with the functions revealed. (You do this by pressing the CTRL + tilde(`)).

	A	B	C	D	E	F
1			**Sales in Units:**			
2		**Apparel**	**Jan**	**Feb**	**Mar**	**Total**
3		Hats	15	12	17	**=SUM(C3:E3)**
4		Shoes	5	8	2	**=SUM(C4:E4)**
5		Shirts	12	20	15	**=SUM(C5:E5)**
6		**Total**	**=SUM(C3:C5)**	**=SUM(D3:D5)**	**=SUM(E3:E5)**	
7						

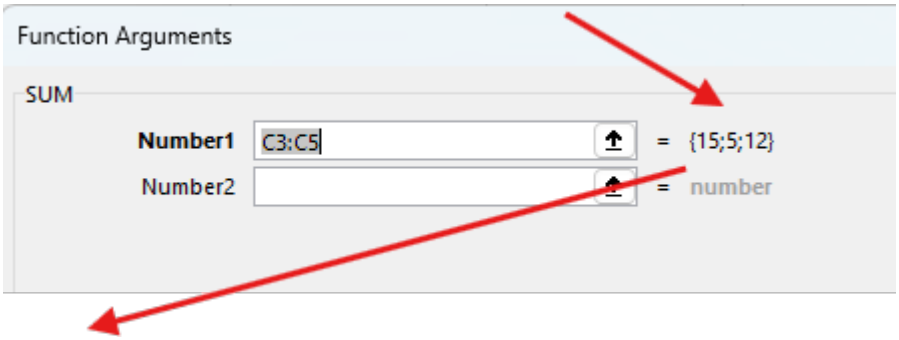
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

One-dimensional vertical arrays:

Consider the SUM function in cell C6. If you examine the function using the Insert Function



You will be able to see the array Excel is using for the function.



{15;5;12}

The formula is instructing Excel to do this:

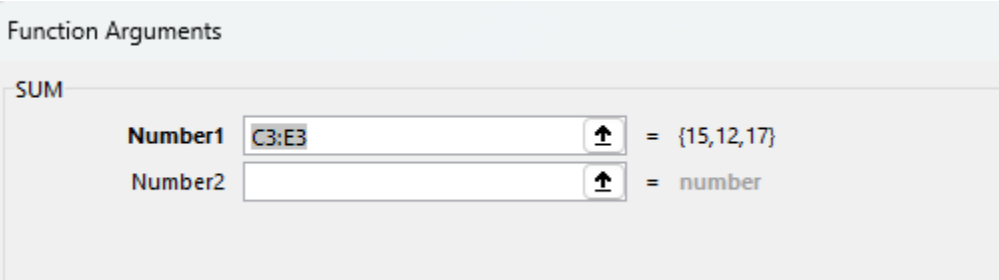
1. Take the values from cell C3:C5 and store them in an array. (The array resides in the computer's memory.)
2. Add each number in the array together.
3. Return the sum of all values in the array to cell C6.

This is an example of a **one-dimensional vertical array**. Each of the values within the array is called an argument (numbers in this case) and are separated by semi-colons. The array is enclosed within curly brackets. {}. It is a vertical array because the data originated in a column. It is one-dimensional because the data is only one column.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

One-dimensional horizontal arrays:

Now let's look at the SUM function in cell F3



{15,12,17}

The arguments in a horizontal array are separated by commas. This is how Excel knows which direction the cells are going in the arrays.

Two-Dimensional Arrays

In the above examples of one-dimensional arrays, we examined the following arrays:

- One-dimensional vertical array. For example:

  {15;5;12}

- One-dimensional horizontal array: For example:

  {15,12,17}

Adding the quarterly total to the worksheet used in the previous example will create a two-dimensional array. The cells being summed are in the blue shaded area and the function is in F8.

	A	B	C	D	E	F	G
1			**Sales in Units:**				
2		**Apparel**	**Jan**	**Feb**	**Mar**	**Total**	
3		Hats	15	12	17	**44**	
4		Shoes	5	8	2	**15**	
5		Shirts	12	20	15	**47**	
6		**Total**	**32**	**40**	**34**		
7							
8		**Quarterly total**				=SUM(C3:E5)	
9							

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

When the function is examined in the Insert Function dialog box, the array is displayed.

Notice that this time the array contains both commas and semicolons.

{15,12,17;5,8,2;12,20,15} denoting the three lines of values. Each line of values is called an "element".

{

15,12,17;

5,8,2;

12,20,15

}

Since Excel ranges are always rectangular each row must contain the same number of values. A two-dimensional array is just a one-dimensional array where each element is itself a one-dimensional array.

Dynamic Array Formulas:

In 2002 Microsoft introduced the Dynamic Array Formula. The Excel calculation engine was fundamentally changed and has changed the way many existing Excel functions can now be used.

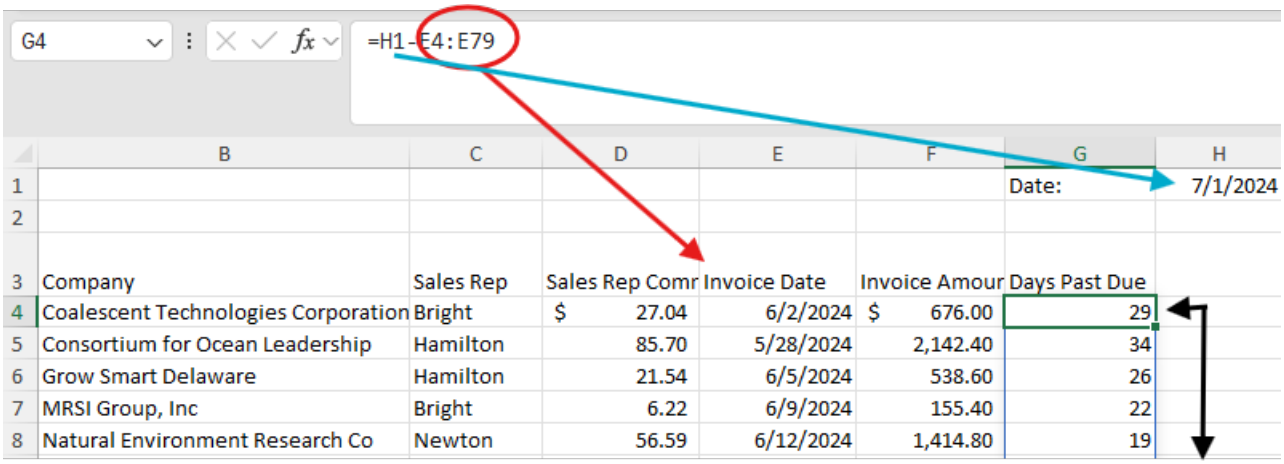
Spilling

Dynamic array formulas introduced the concept of "spilling". In legacy Excel versions before 365, Excel functions could only return a single value to a single cell. Dynamic array formulas can return arrays of variable size that can spill to the right and/or below the cell containing the function or formula.

As an example: a formula that will used in an Exercise in Chapter 3 asks you to calculate the days past due. This formula takes a current date and subtracts the invoice dates found in a column of dates. This is a one-to-many formula. One date to many results. In legacy Excel the formula would need to be written as =current date – cell that contained the invoice date.

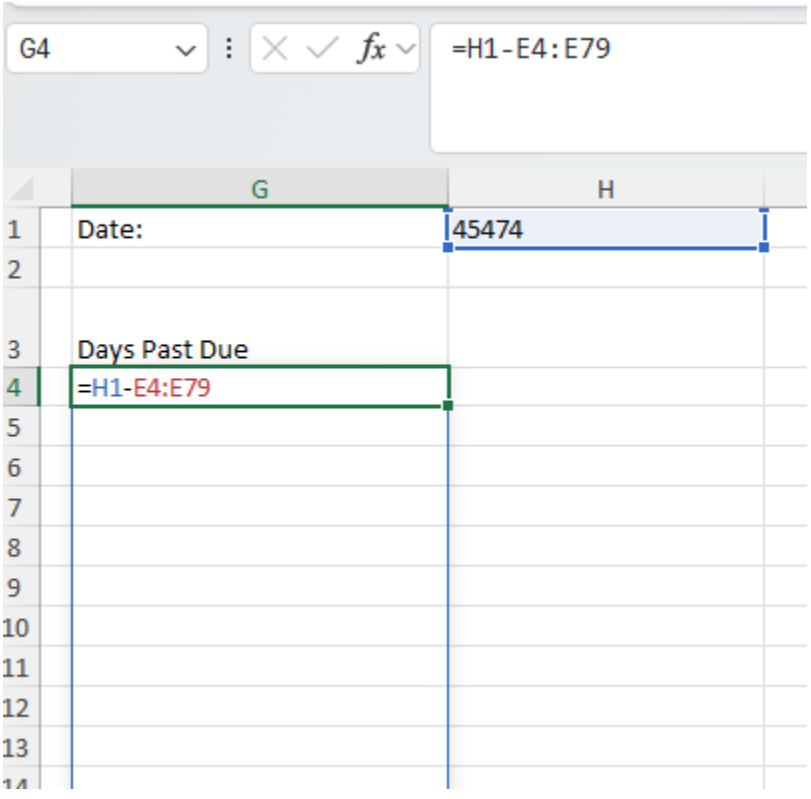
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

This would then be copied down the page. The current date would need to be an absolute cell reference (covered later) for the cell to copy correctly. With the ability to spill through a range of data the formula can now be written as current date in H1 – E4:E79 the dynamic array. The results are shown below. There is no copying involved and no anchoring of cells. Excel knows to copy the formula through the dynamic array cells given.



	B	C	D	E	F	G	H
1						Date:	7/1/2024
2							
3	Company	Sales Rep	Sales Rep Comm	Invoice Date	Invoice Amour	Days Past Due	
4	Coalescent Technologies Corporation	Bright	$ 27.04	6/2/2024	$ 676.00	29	
5	Consortium for Ocean Leadership	Hamilton	85.70	5/28/2024	2,142.40	34	
6	Grow Smart Delaware	Hamilton	21.54	6/5/2024	538.60	26	
7	MRSI Group, Inc	Bright	6.22	6/9/2024	155.40	22	
8	Natural Environment Research Co	Newton	56.59	6/12/2024	1,414.80	19	

This is better examined using the examine function view as seen below. Note that the formula is only in cell G4 on the worksheet. Excel fills in the rest of the cells visually but does not actually put a formula in the range of cells E5:E79.



=H1-E4:E79 The original formula is black and can be edited.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

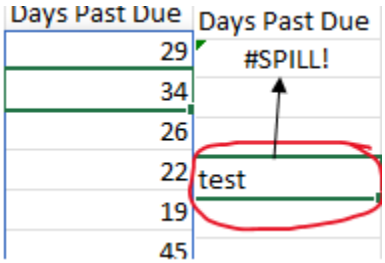
=H1-E4:E79 Dynamic array formulas in remaining cells are gray and cannot be edited.

Spilled arrays can be added in many other types of functions. However, they currently cannot be used in nested logical functions.

#Spill and #CALC! errors

If any of the cells that results should spill into are not empty, a #SPILL error will occur.

If a calculation error is detected within an array, a #CALC error will occur.



Dynamic array functions are intended to entirely replace the older legacy array formulas. For new work you should always use Dynamic Array Functions. Support for legacy array functions is only retained for compatibility purposes.

Note: Dynamic arrays are not supported in tables. Tables are covered in Chapter 5.

Integrity Check
What qualifies as a Dynamic Array function? This term was initiated with Excel 365 because of the dynamic nature of working with spilled ranges. Originally it referred to SORT, SORTBY, SEQUENCE, FILTER, UNITQUE, and RANDARRAY functions. However, many existing functions work well with spilled ranges allowing the term to apply to any function that can output a spilled range.

2.3 Statistical Functions

In addition to formulas, another way to conduct mathematical computations in Excel is through functions. Statistical functions apply a mathematical process to a group of cells in a worksheet. For example, the SUM function is used to add values contained in a range of cells. A list of commonly used statistical functions is shown in Table 2.4 "Commonly Used Statistical Functions". Functions are more efficient than formulas when you are applying a mathematical process to a group of cells. If you use a formula to add the values in a range of cells, you have to add each cell location to the formula one at a time. This can be very time-consuming if you must add values in a few hundred cell locations. However, when you use

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

a function, you can highlight all the cells that contain values you wish to sum in just one step. This section demonstrates a variety of statistical functions that we will add to the Personal Budget workbook. In addition to demonstrating functions, this section also reviews percent of total calculations and the use of absolute references.

LEARNING OBJECTIVES
4. Use the **SUM function** to calculate totals. 5. Use **absolute references** to calculate percent of total. 6. Use the **COUNT function** to count cell locations with numerical values. 7. Use the **AVERAGE function** to calculate the arithmetic mean. 8. Use the **MAX and MIN functions** to find the highest and lowest values in a range of cells. 9. Use the AutoSum feature to quickly insert statistical functions. 10. Learn how to copy and paste formulas without formats applied to a cell location. 11. Learn how to set a **multiple level sort** sequence for data sets that have duplicate values or outputs.

Table 2.4 Commonly Used Statistical Functions

Function	Output
ABS	The absolute value of a number
AVERAGE	The average or arithmetic mean for a group of numbers
COUNT	The number of cell locations in a range that contain a numeric character
COUNTA	The number of cell locations in a range that contain a text or numeric character
MAX	The highest numeric value in a group of numbers
MEDIAN	The middle number in a group of numbers (half the numbers in the group are higher than the median and half the numbers in the group are lower than the median)
MIN	The lowest numeric value in a group of numbers
MODE	The number that appears most frequently in a group of numbers
PRODUCT	The result of multiplying all the values in a range of cell locations
SQRT	The positive square root of a number
STDEV.S	The standard deviation for a group of numbers based on a sample
SUM	The total of all numeric values in a group

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

The SUM Function

Follow-along file: Continue with Excel Objective 2.00. (Use file Excel Objective 2.03 if starting here.)

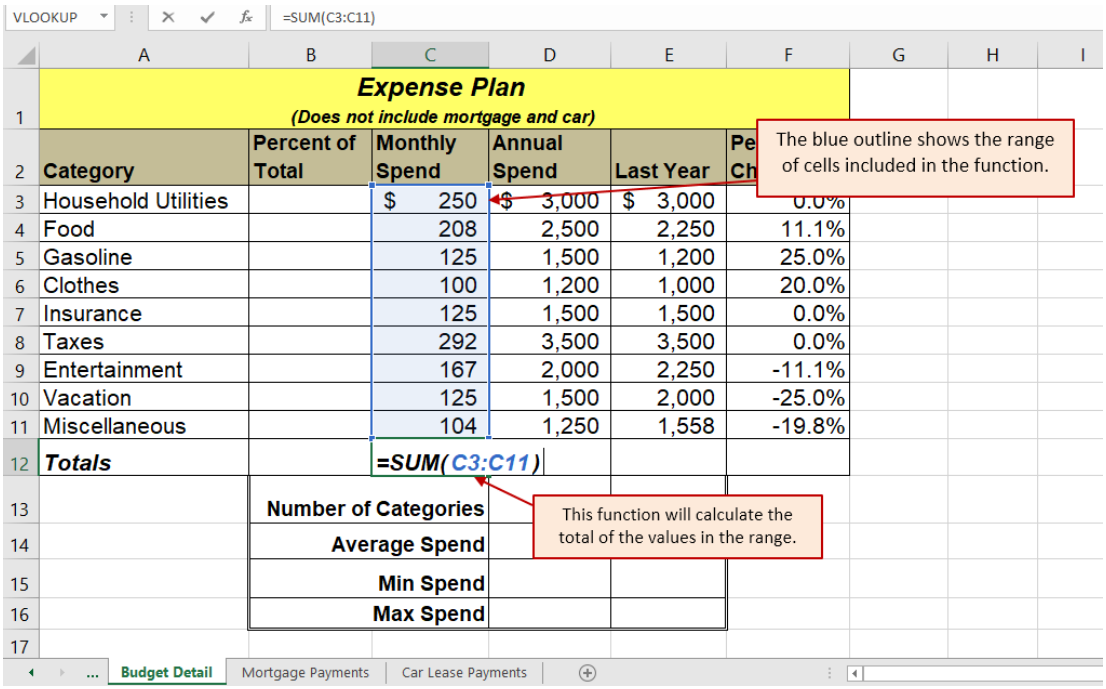
The SUM function is used when you need to calculate totals for a range of cells or a group of selected cells on a worksheet. Regarding the **Budget Detail** worksheet, we will use the SUM function to calculate the totals in row 12. It is important to note that there are several methods for adding a function to a worksheet, which will be demonstrated throughout the remainder of this chapter. The following illustrates how a function can be added to a worksheet by typing it into a cell location:

1. Click the **Budget Detail** worksheet tab to open the worksheet.
2. Click cell C12.
3. Type an equal sign (**=**).
4. Type the function name **SUM**.
5. Type an open parenthesis (**(**).
6. Click cell C3 and drag down to cell C11. This places the range C3:C11 into the function.
7. Type a closing parenthesis *Note: you can hit enter without the closing parenthesis and Excel will insert it for you.*
8. Press the ENTER key. The function calculates the total for the Monthly Spend column, which is $1,496.

Figure 2.11 "Adding the SUM Function to the Budget Detail Worksheet" shows the appearance of the SUM function added to the **Budget Detail** worksheet before pressing the ENTER key.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.11 Adding the SUM Function to the Budget Detail Worksheet


VLOOKUP
=SUM(C3:C11)
Expense Plan
(Does not include mortgage and car)
Category
Percent of Total
Monthly Spend
Annual Spend
Last Year
Household Utilities $ 250 $ 3,000 $ 3,000 0.0%
Food 208 2,500 2,250 11.1%
Gasoline 125 1,500 1,200 25.0%
Clothes 100 1,200 1,000 20.0%
Insurance 125 1,500 1,500 0.0%
Taxes 292 3,500 3,500 0.0%
Entertainment 167 2,000 2,250 -11.1%
Vacation 125 1,500 2,000 -25.0%
Miscellaneous 104 1,250 1,558 -19.8%
Totals =SUM(C3:C11)
Number of Categories
Average Spend
Min Spend
Max Spend
The blue outline shows the range of cells included in the function.
This function will calculate the total of the values in the range.
Budget Detail
Mortgage Payments
Car Lease Payments

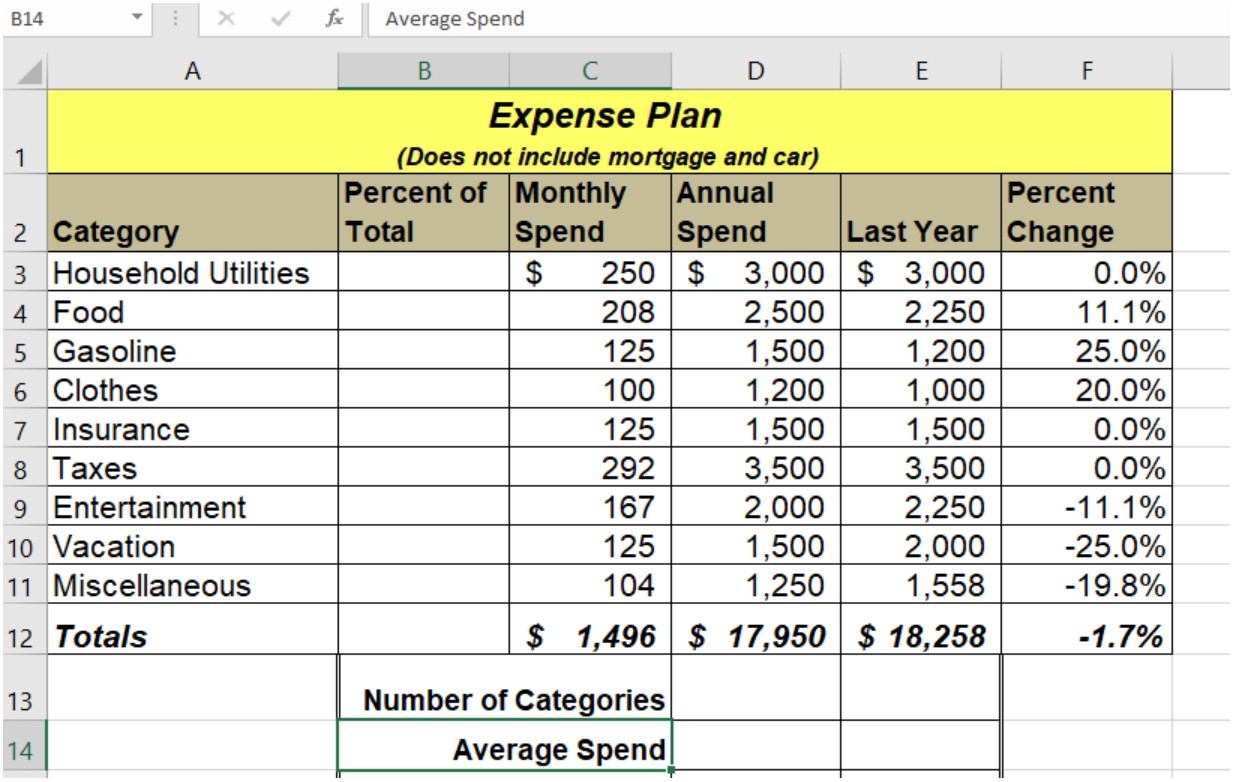
As shown in Figure 2.11 "Adding the SUM Function to the Budget Detail Worksheet", the SUM function was added to cell C12. However, this function is also needed to calculate the totals in the Annual Spend and LY Spend columns. The function can be copied and pasted into these cell locations because of relative referencing. Relative referencing serves the same purpose for functions as it does for formulas. The following demonstrates how the total row is completed:

1. Click cell C12 in the **Budget Detail** worksheet.
2. Use the fill handle in the lower right corner to copy the formula across to cells D12:E12.Activate cell F12 and click on the AutoSum button in the Editing section of the Home ribbon. Hit Enter. Then increase decimal places to one.
3. Click cell F11.
4. Click the Copy button in the Home tab of the Ribbon.
5. Click cell F12, then click the Paste button in the Home tab of the Ribbon. Since we now have totals in row 12, we can paste the percent change formula into this row.

Figure 2.12 "Results of the SUM Function in the Budget Detail Worksheet" shows the output of the SUM function that was added to cells C12, D12, and E12. In addition, the percent change formula was copied and pasted into cell F12. Notice that this version of the budget is planning a 1.7% decrease in spending compared to last year.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.12 Results of the SUM Function in the Budget Detail Worksheet



B14 | Average Spend

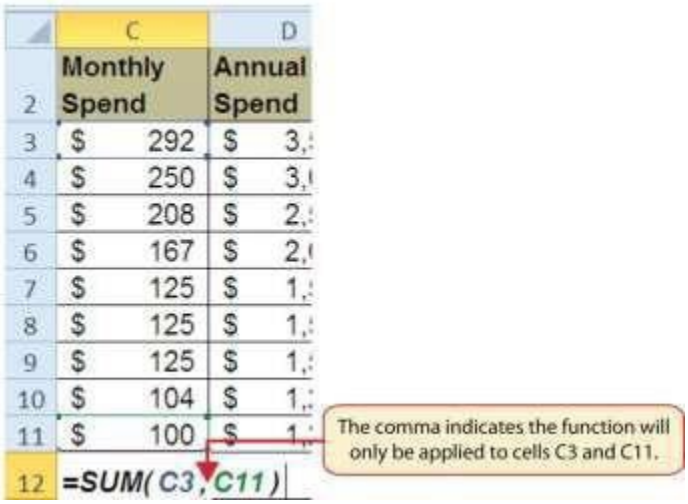
	A	B	C	D	E	F
1	***Expense Plan*** ***(Does not include mortgage and car)***					
2	**Category**	**Percent of Total**	**Monthly Spend**	**Annual Spend**	**Last Year**	**Percent Change**
3	Household Utilities		$ 250	$ 3,000	$ 3,000	0.0%
4	Food		208	2,500	2,250	11.1%
5	Gasoline		125	1,500	1,200	25.0%
6	Clothes		100	1,200	1,000	20.0%
7	Insurance		125	1,500	1,500	0.0%
8	Taxes		292	3,500	3,500	0.0%
9	Entertainment		167	2,000	2,250	-11.1%
10	Vacation		125	1,500	2,000	-25.0%
11	Miscellaneous		104	1,250	1,558	-19.8%
12	***Totals***		***$ 1,496***	***$ 17,950***	***$ 18,258***	***-1.7%***
13		**Number of Categories**				
14		**Average Spend**				

Integrity Check – Cell Ranges in Statistical Functions

When you intend to use a statistical function on a range of cells in a worksheet, make sure there are two cell locations separated by a colon and not a comma. If you enter two cell locations separated by a comma, the function will produce an output, but it will be applied to only two cell locations instead of a range of cells. For example, the SUM function shown in Figure 2.13 "SUM Function Adding Two Cell Locations" will add only the values in cells C3 and C11, not the range C3:C11.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.13 SUM Function Adding Two Cell Locations



Absolute References (Calculating Percent of Totals)

Follow-along file: Continue with Excel Objective 2.00. (Use file Excel Objective 2.04 if starting here.)

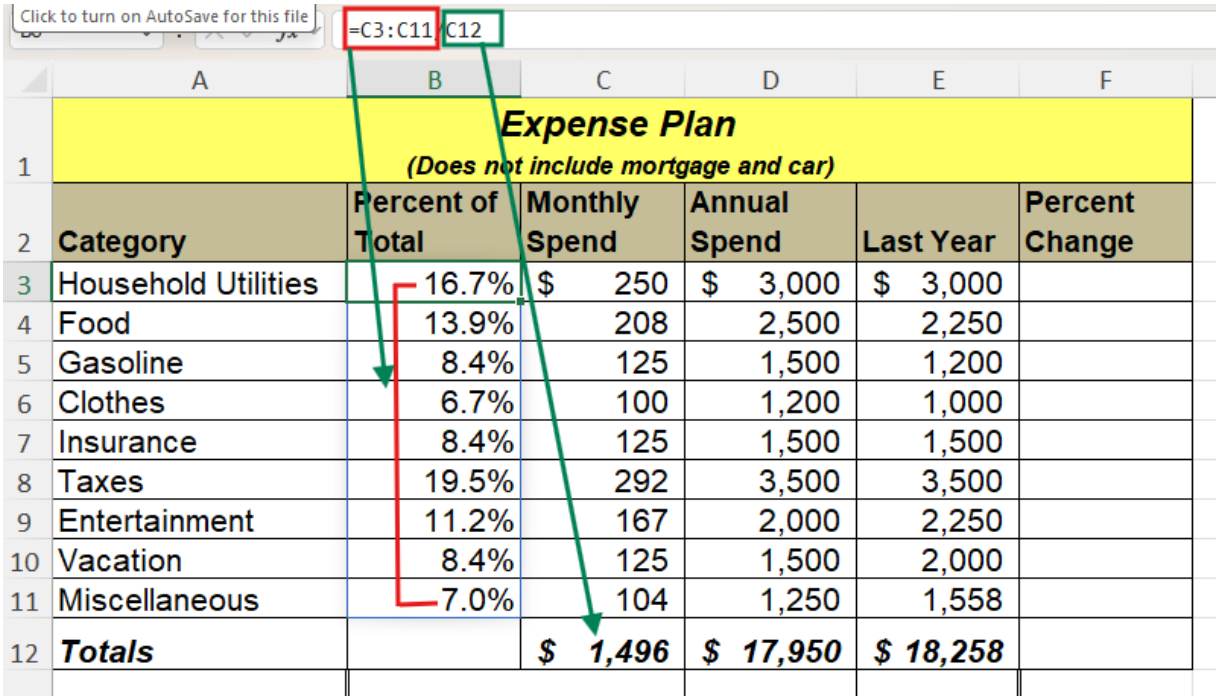
Since totals were added to row 12 of the **Budget Detail** worksheet, a percent of total calculation can be added to Column B beginning in cell B3. The percent of total calculation shows the percentage for each value in the Annual Spend column with respect to the total annual spend in cell D12. However, in legacy Excel it would have been necessary to anchor the total spend cell D12 it would be necessary to turn off Excel's relative referencing feature before copying and pasting the formula to the rest of the cell locations in the column. Turning off Excel's relative referencing feature is accomplished by creating an absolute cell reference. An absolute cell reference will remain locked in a formula no matter where the formula is copied to. An absolute cell reference is accomplished by using the F4 function key why the cell to be anchored is selected.

With dynamic arrays, it is often no longer necessary to anchor a cell because the dynamic array will recognize it as a cell that should not change.

1. Click cell B3 in the **Budget Detail** worksheet.
2. Type an equal sign (=).
3. Highlight cells D3:D11. The range will create a spill in the range of cells
4. Type a forward slash (/).
5. Click select cells D12.
6. Press the ENTER key. Excel will spill the array results through B4:B11 (see Figure 2.14 "Adding a Formula to Calculate the Percent of Total").

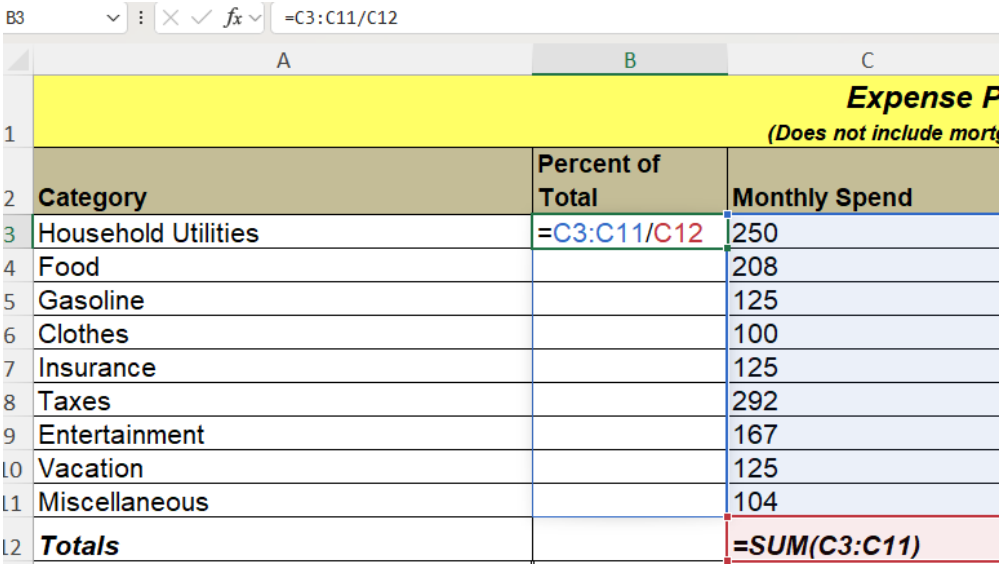
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.14 Adding a Formula to Calculate the Percent of Total



	A	B	C	D	E	F
1	**Expense Plan** (Does not include mortgage and car)					
2	**Category**	**Percent of Total**	**Monthly Spend**	**Annual Spend**	**Last Year**	**Percent Change**
3	Household Utilities	16.7%	$ 250	$ 3,000	$ 3,000	
4	Food	13.9%	208	2,500	2,250	
5	Gasoline	8.4%	125	1,500	1,200	
6	Clothes	6.7%	100	1,200	1,000	
7	Insurance	8.4%	125	1,500	1,500	
8	Taxes	19.5%	292	3,500	3,500	
9	Entertainment	11.2%	167	2,000	2,250	
10	Vacation	8.4%	125	1,500	2,000	
11	Miscellaneous	7.0%	104	1,250	1,558	
12	***Totals***		***$ 1,496***	***$ 17,950***	***$ 18,258***	

In this screenshot of the formula view for the percent of total, you can see that only the first cell in the range has a formula. The rest of the results are spilled from the first cell**. Note that using the dynamic array C3:C11 recognizes that the cell C12 is to remain anchored in the formula. Excel automatically treats C12 as an absolute cell reference.**



	A	B	C
1			***Expense P*** (Does not include mort
2	**Category**	**Percent of Total**	**Monthly Spend**
3	Household Utilities	=C3:C11/C12	250
4	Food		208
5	Gasoline		125
6	Clothes		100
7	Insurance		125
8	Taxes		292
9	Entertainment		167
10	Vacation		125
11	Miscellaneous		104
12	***Totals***		***=SUM(C3:C11)***

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Excel for Mac
To use the function keys, you must press the Cmd key at the bottom left corner of the keyboard

Figure 2.16 "Adding an Absolute Reference to a Cell Reference in a Formula" shows the percent of total formula with an absolute reference added to D12. Notice that in cell B4, the cell reference remains D12 instead of changing to D13 as shown in Figure 2.15 "#DIV/0 Error from Relative Referencing". Also, you will see that the percentages are being calculated in the rest of the cells in the column, and the divide-by- zero error is now eliminated.

The COUNT Function

Follow-along file: Continue with Excel Objective 2.00. (Use file Excel Objective 2.05 if starting here.)

The next function that we will add to the **Budget Detail** worksheet is the COUNT function. The COUNT function is used to determine how many cells in a range contain a numeric entry. The function will count only those cells that have a numeric entry. Cells that contain text, or are blank, will not be included in the total count.

For the **Budget Detail** worksheet, we will use the COUNT function to count the number of items that are planned in the Annual Spend column (Column D). The following explains how the COUNT function is added to the worksheet by using the function list:

1. Click cell D13 in the **Budget Detail** worksheet.
2. Type an equal sign (**=**).
3. Type the letter **C**.
4. Click the down arrow on the scroll bar of the function list (see Figure 2.17 "Using the Function List to Add the COUNT Function") and find the word *COUNT*.
5. Double click the word *COUNT* from the function list.
6. Highlight the range D3:D11.
7. Type a closing parenthesis).
8. Press the ENTER key. The function produces an output of 9 since there are 9 items planned on the worksheet.

Figure 2.17 "Using the Function List to Add the COUNT Function" shows the function list box that appears after completing steps 2 and 3 for the COUNT function. The function list provides an alternative method for adding a function to a worksheet.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.17 Using the Function List to Add the COUNT Function

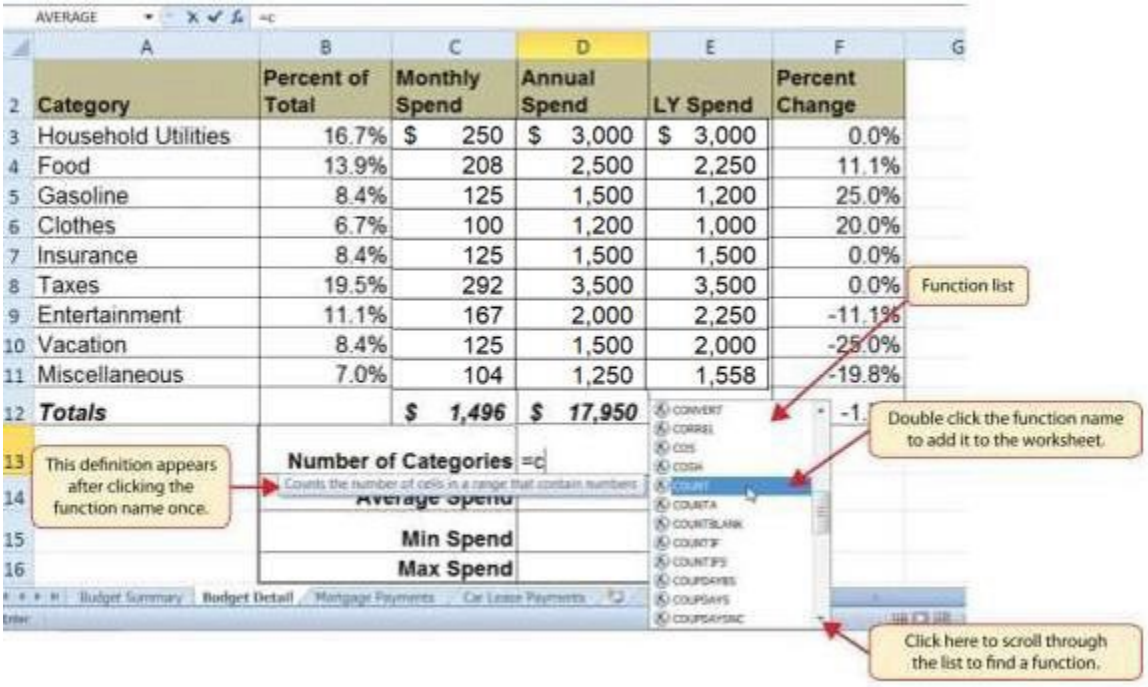
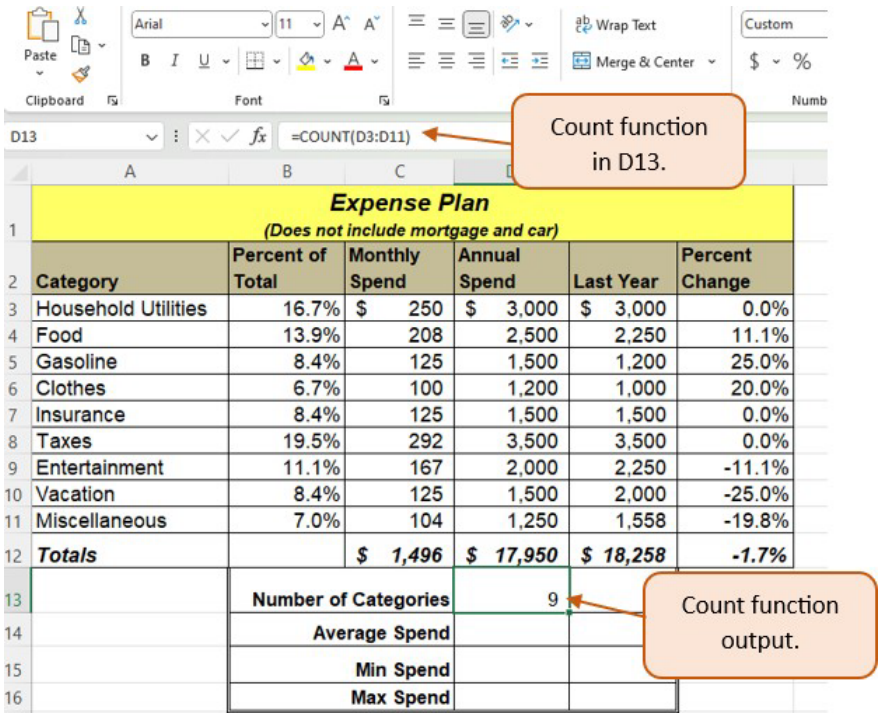

Function list
Double click the function name to add it to the worksheet.
This definition appears after clicking the function name once.
Click here to scroll through the list to find a function.

Figure 2.18 "Completed COUNT Function in the Budget Detail Worksheet" shows the output of the COUNT function after pressing the ENTER key. The function counts the number of cells in the range D3:D11 that contain a numeric value. The result of 9 indicates that there are 9 categories planned for this budget.

Figure 2.18 Completed COUNT Function in the Budget Detail Worksheet



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

The AVERAGE Function

Follow-along file: Continue with Excel Objective 2.00. (Use file Excel Objective 2.06 if starting here.)

The next function we will add to the **Budget Detail** worksheet is the AVERAGE function. This function is used to calculate the arithmetic mean for a group of numbers. For the **Budget Detail** worksheet, we will use the function to calculate the average of the values in the Annual Spend column. We will add this to the worksheet by using the Function Library. The following steps explain how this is accomplished:

1. Click cell D14 in the **Budget Detail** worksheet.
2. Click the Formulas tab on the Ribbon.
3. Click the More Functions button in the Function Library group of commands.
4. Place the mouse pointer over the Statistical option from the drop-down list of options. Click the AVERAGE function name from the list of functions that appear in the menu (see Figure 2.19 "Selecting the AVERAGE Function from the Function Library"). This opens the Function Arguments dialog box.
5. Click the Collapse Dialog button in the Function Arguments dialog box (see Figure 2.20 "Function Arguments Dialog Box").
6. Highlight the range D3:D11.
7. Click the Expand Dialog button in the Function Arguments dialog box (see Figure 2.21 "Selecting a Range from the Function Arguments Dialog Box"). You can also press the ENTER key to get the same result.
8. Click the OK button on the Function Arguments dialog box. This adds the AVERAGE function to the worksheet.

Figure 2.19 "Selecting the AVERAGE Function from the Function Library" illustrates how a function is selected from the Function Library in the Formulas tab of the Ribbon.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.19 Selecting the AVERAGE Function from the Function Library

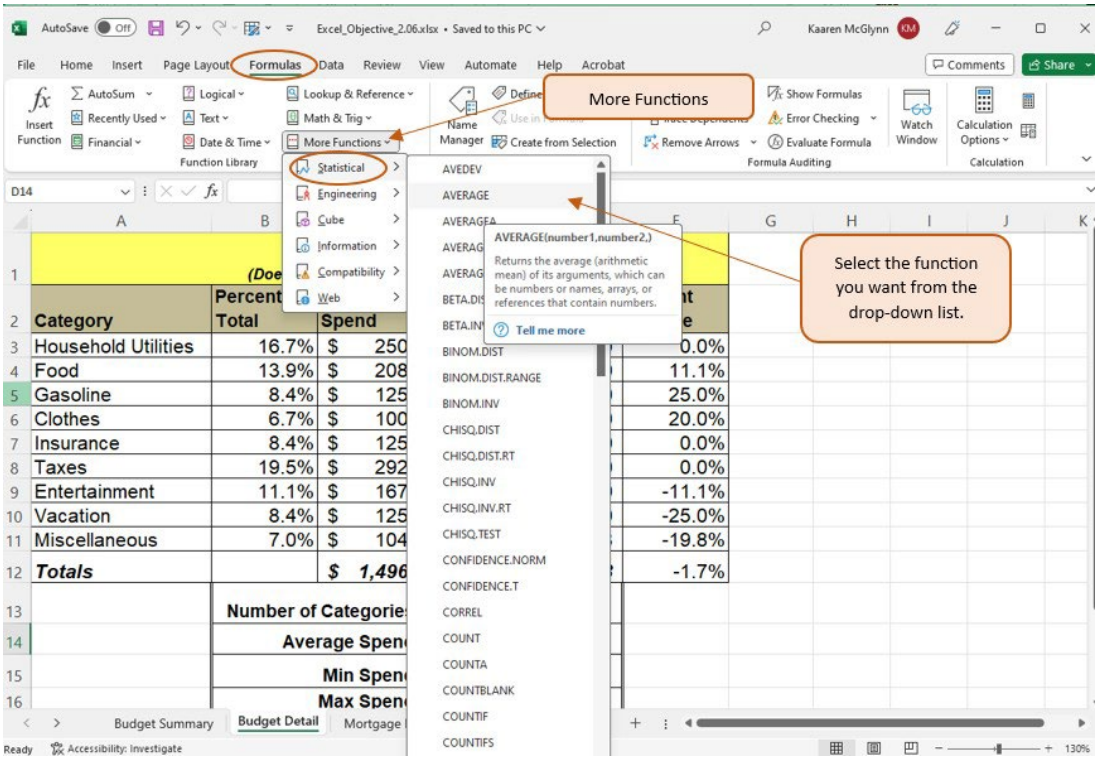

More Functions
Select the function you want from the drop-down list.
AVERAGE(number1,number2,)
Returns the average (arithmetic mean) of its arguments, which can be numbers or names, arrays, or references that contain numbers.
Tell me more

Figure 2.20 "Function Arguments Dialog Box" shows the Function Arguments dialog box. This appears after a function is selected from the Function Library. The Collapse Dialog button is used to hide the dialog box so a range of cells can be highlighted on the worksheet and then added to the function.

Figure 2.20 Function Arguments Dialog Box

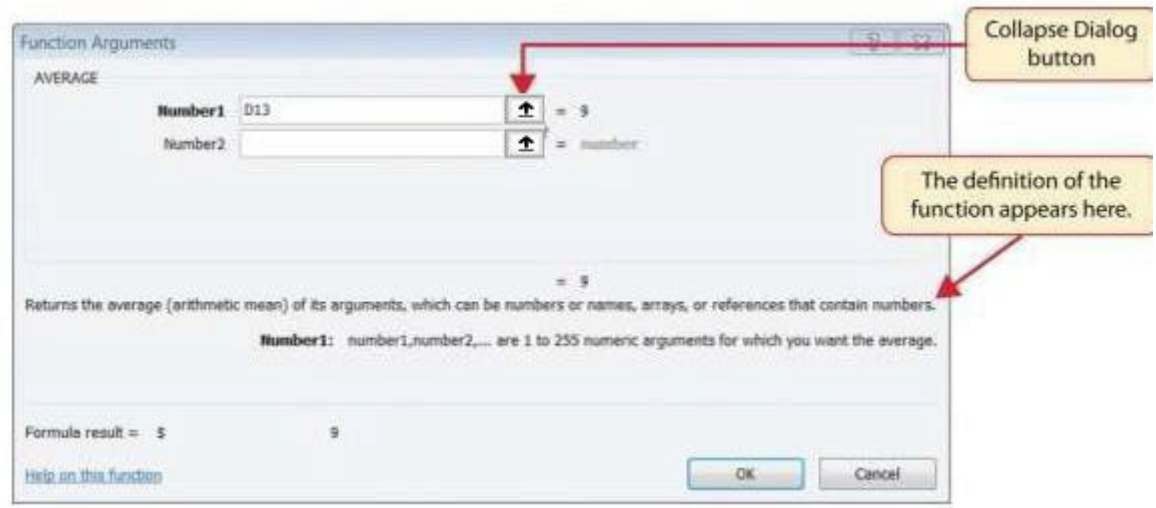

Collapse Dialog button
The definition of the function appears here.
Function Arguments
AVERAGE
Number1
D13
Number2
Returns the average (arithmetic mean) of its arguments, which can be numbers or names, arrays, or references that contain numbers.
Number1: number1,number2,... are 1 to 255 numeric arguments for which you want the average.
Formula result =
Help on this function
OK
Cancel

Figure 2.21 "Selecting a Range from the Function Arguments Dialog Box" shows how a range of cells can be selected from the Function Arguments dialog box once it has been collapsed.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.21 Selecting a Range from the Function Arguments Dialog Box

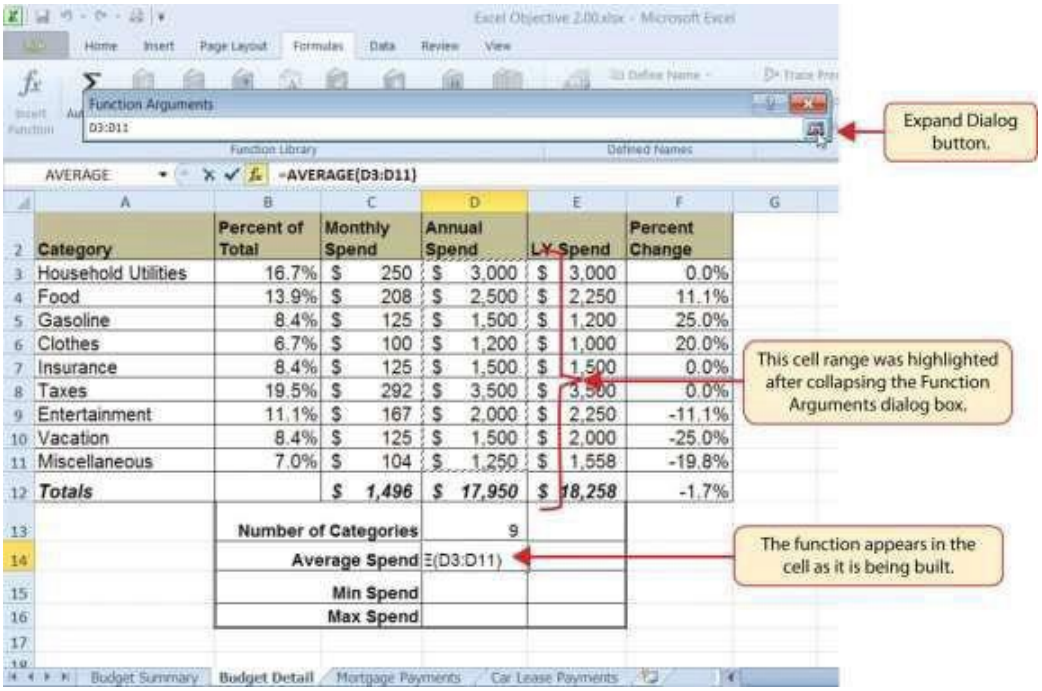
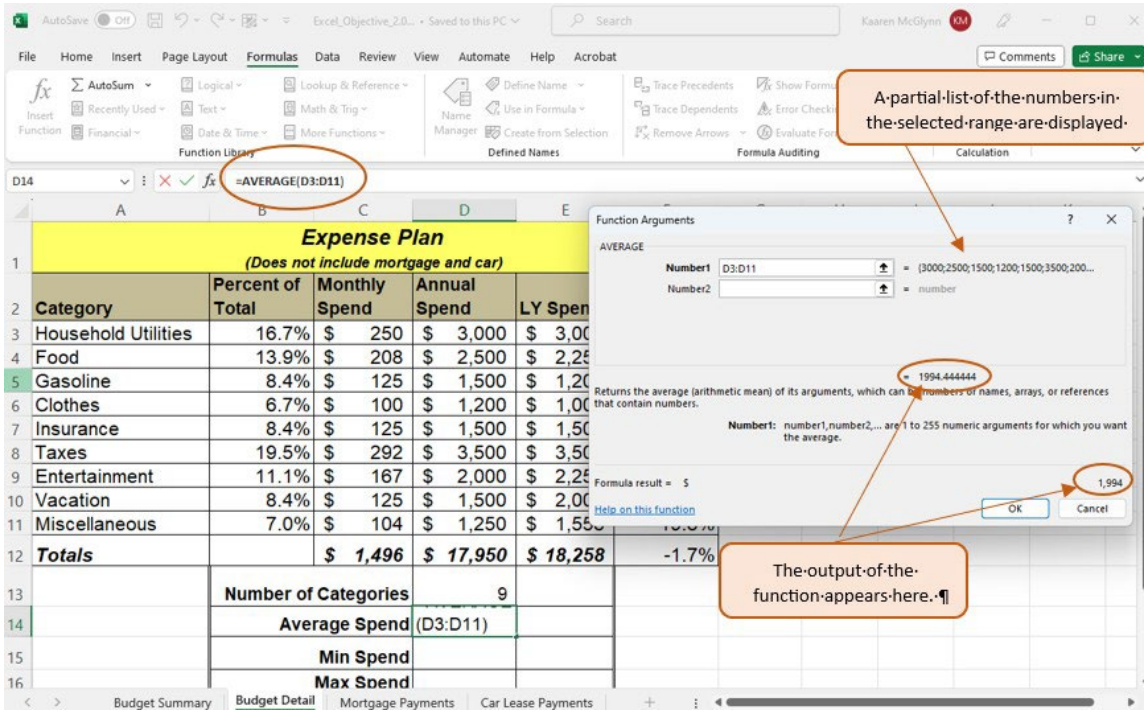

Function Arguments
D3:D11
Expand Dialog button.
=AVERAGE(D3:D11)
This cell range was highlighted after collapsing the Function Arguments dialog box.
The function appears in the cell as it is being built.
Number of Categories 9
Average Spend =(D3:D11)
Min Spend
Max Spend

Figure 2.22 "Function Arguments Dialog Box after a Cell Range Is Defined for a Function" shows the Function Arguments dialog box after the cell range is defined for the AVERAGE function. The dialog box shows the result of the function before it is added to the cell location. This allows you to assess the function output to determine whether it makes sense before adding it to the worksheet.

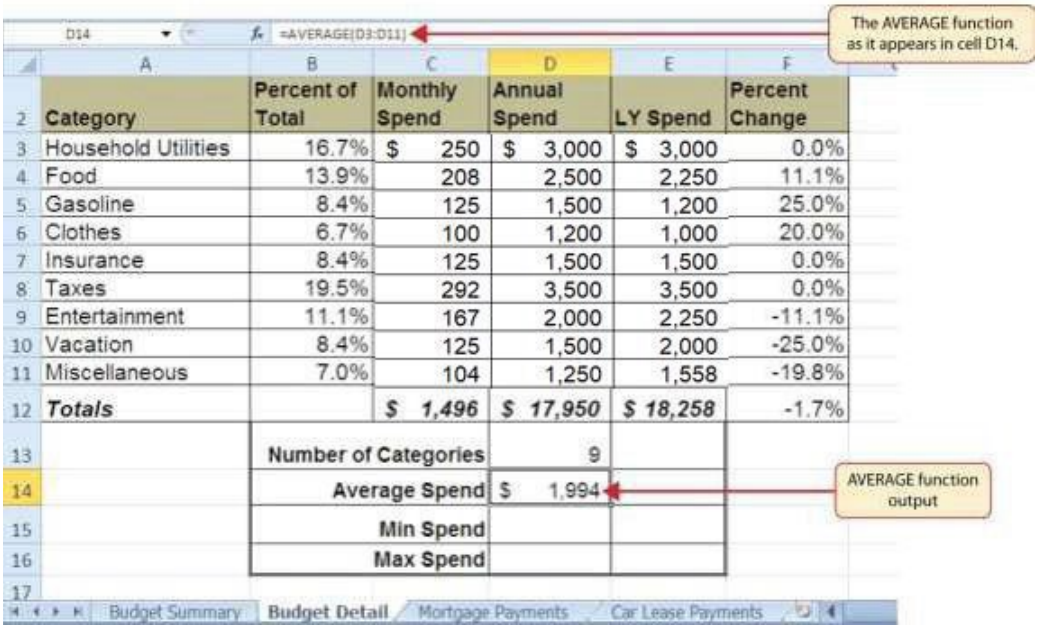
Figure 2.22 Function Arguments Dialog Box after a Cell Range Is Defined for a Function



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.23 "Completed AVERAGE Function" shows the completed AVERAGE function in the **Budget Detail** worksheet. The output of the function shows that on average we expect to spend $1,994 for each of the categories listed in Column A of the budget. This average spend calculation per category can be used as an indicator to determine which categories are costing more or less than the average budgeted spend dollars.

Figure 2.23 Completed AVERAGE Function



	A	B	C	D	E	F
2	Category	Percent of Total	Monthly Spend	Annual Spend	LY Spend	Percent Change
3	Household Utilities	16.7%	$ 250	$ 3,000	$ 3,000	0.0%
4	Food	13.9%	208	2,500	2,250	11.1%
5	Gasoline	8.4%	125	1,500	1,200	25.0%
6	Clothes	6.7%	100	1,200	1,000	20.0%
7	Insurance	8.4%	125	1,500	1,500	0.0%
8	Taxes	19.5%	292	3,500	3,500	0.0%
9	Entertainment	11.1%	167	2,000	2,250	-11.1%
10	Vacation	8.4%	125	1,500	2,000	-25.0%
11	Miscellaneous	7.0%	104	1,250	1,558	-19.8%
12	***Totals***		***$ 1,496***	***$ 17,950***	***$ 18,258***	-1.7%
13		**Number of Categories**		9		
14		**Average Spend**		$ 1,994		
15		**Min Spend**				
16		**Max Spend**				
17						

The MAX and MIN Functions

Follow-along file: Continue with Excel Objective 2.00. (Use file Excel Objective 2.07 *if starting here.)*

The final two statistical functions that we will add to the **Budget Detail** worksheet are the MAX and MIN functions. These functions identify the highest and lowest values in a range of cells. The following steps explain how to add these functions to the **Budget Detail** worksheet:

1. Click cell D15 in the **Budget Detail** worksheet.
2. Type an equal sign (**=**).
3. Type the word **MIN**.
4. Type an open parenthesis (**(**).
5. Highlight the range D3:D11.
6. Type a closing parenthesis **).**

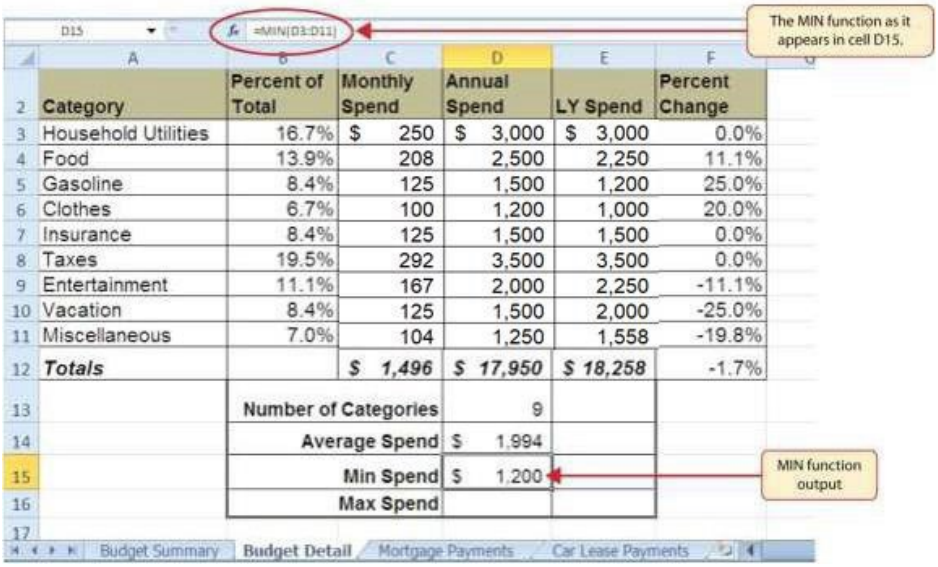
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

7. Press the ENTER key. The MIN function produces an output of $1,200, which is the lowest value in the Annual Spend column (see Figure 2.24 "MIN Function Added to the Budget Detail Worksheet").

Let's try a different method using the AutoSum feature.

8. Click cell D16.
9. Click on the drop-down menu to the right of the AutoSum in the Editing section of the Home ribbon. (You can also use the AutoSum on the left side of the Formulas ribbon)
10. Select **MAX**.
11. Highlight the range D3: D11.
12. Press the ENTER key. The MAX function produces an output of $3,500. This is the highest value in the Annual Spend column (see Figure 2.25 "MAX Function Added to the Budget Detail Worksheet").

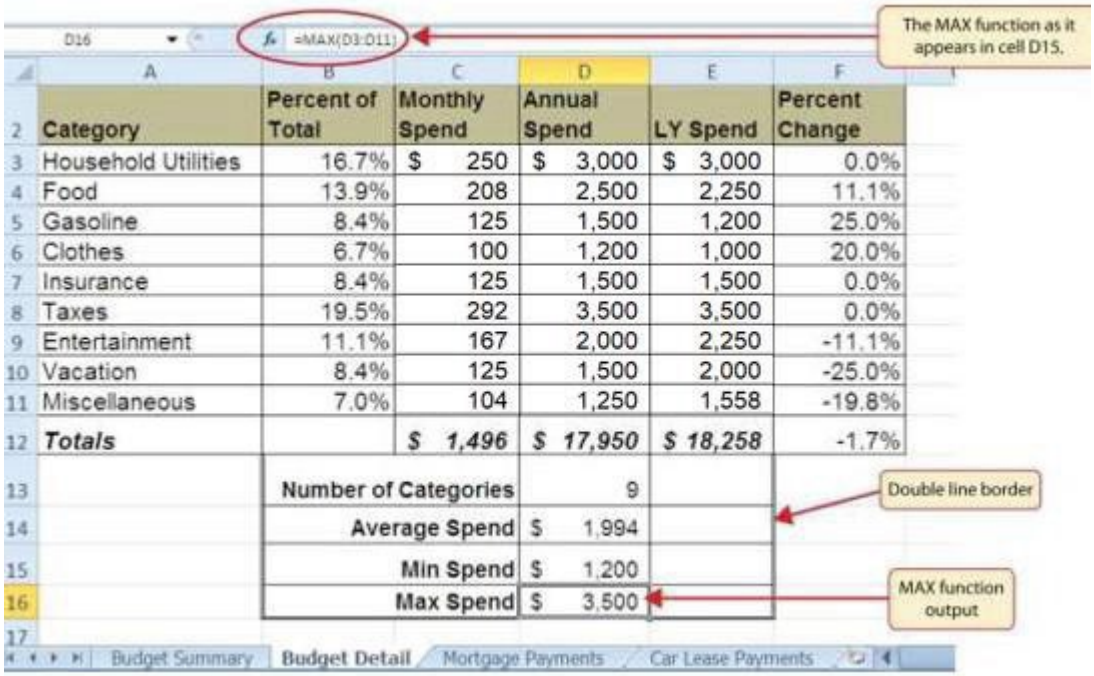
Figure 2.24 *MIN Function Added to the Budget Detail Worksheet*



	A	B	C	D	E	F
2	Category	Percent of Total	Monthly Spend	Annual Spend	LY Spend	Percent Change
3	Household Utilities	16.7%	$ 250	$ 3,000	$ 3,000	0.0%
4	Food	13.9%	208	2,500	2,250	11.1%
5	Gasoline	8.4%	125	1,500	1,200	25.0%
6	Clothes	6.7%	100	1,200	1,000	20.0%
7	Insurance	8.4%	125	1,500	1,500	0.0%
8	Taxes	19.5%	292	3,500	3,500	0.0%
9	Entertainment	11.1%	167	2,000	2,250	-11.1%
10	Vacation	8.4%	125	1,500	2,000	-25.0%
11	Miscellaneous	7.0%	104	1,250	1,558	-19.8%
12	***Totals***		***$ 1,496***	***$ 17,950***	***$ 18,258***	-1.7%
13		Number of Categories		9		
14		Average Spend		$ 1,994		
15		Min Spend		$ 1,200		
16		Max Spend				
17						

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.25 *MAX Function Added to the Budget Detail Worksheet*



	A	B	C	D	E	F
2	Category	Percent of Total	Monthly Spend	Annual Spend	LY Spend	Percent Change
3	Household Utilities	16.7%	$ 250	$ 3,000	$ 3,000	0.0%
4	Food	13.9%	208	2,500	2,250	11.1%
5	Gasoline	8.4%	125	1,500	1,200	25.0%
6	Clothes	6.7%	100	1,200	1,000	20.0%
7	Insurance	8.4%	125	1,500	1,500	0.0%
8	Taxes	19.5%	292	3,500	3,500	0.0%
9	Entertainment	11.1%	167	2,000	2,250	-11.1%
10	Vacation	8.4%	125	1,500	2,000	-25.0%
11	Miscellaneous	7.0%	104	1,250	1,558	-19.8%
12	***Totals***		***$ 1,496***	***$ 17,950***	***$ 18,258***	-1.7%
13		Number of Categories		9		
14		Average Spend		$ 1,994		
15		Min Spend		$ 1,200		
16		Max Spend		$ 3,500		
17						

Skill Refresher – Statistical Functions

1. Type an equal sign (=).
2. Type the function name followed by an open parenthesis (**(**) or double click the function name from the function list.
3. Highlight a range on a worksheet or click individual cell locations followed by commas.
4. Type a closing parenthesis **)**.
5. Press the ENTER key.

Copy and Paste Formulas (Pasting without Formats)

Follow-along file: Continue with Excel Objective 2.00. (Use file Excel Objective 2.08 if starting here.)

As shown in Figure 2.25 "MAX Function Added to the Budget Detail Worksheet", the COUNT, AVERAGE, MIN, and MAX functions are summarizing the data in the Annual Spend column. You will also notice that there is space to copy and paste these functions under the LY Spend column. This allows us to compare what we spent last year and what we are planning to spend this year. Normally, we would simply copy and paste these functions into the range E13:E16. However, you may have noticed the double-line style border that

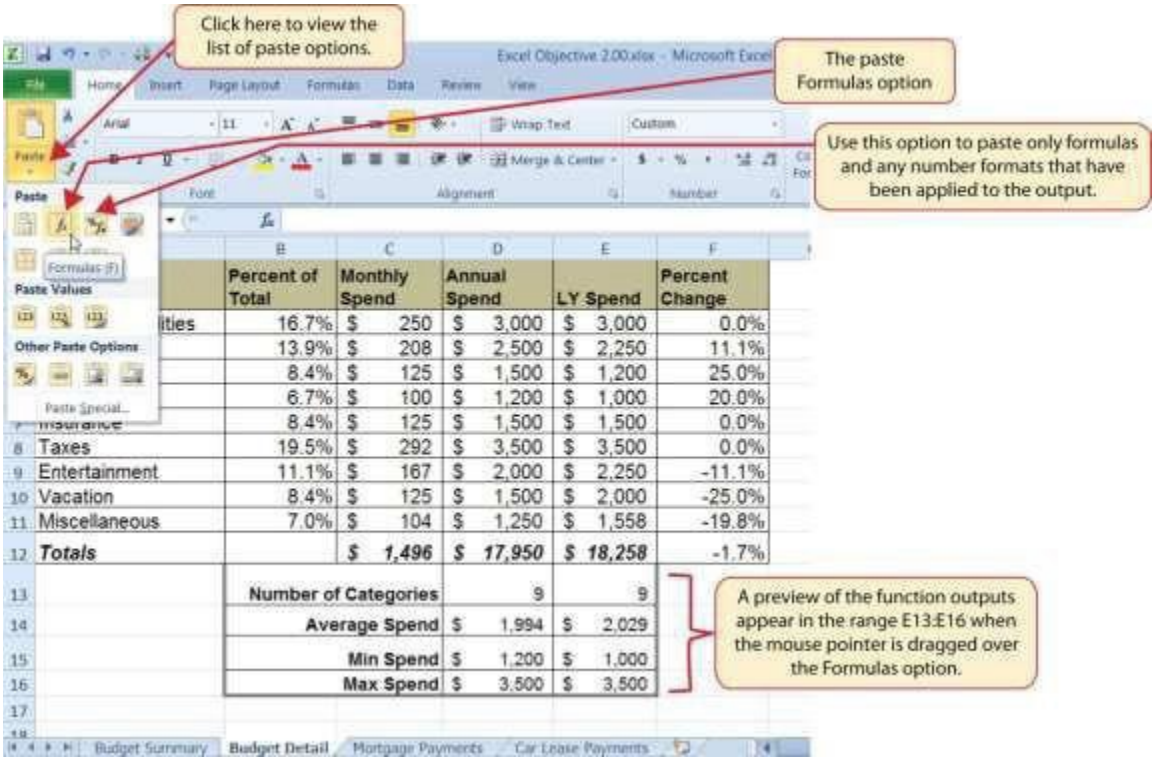
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

was used around the perimeter of the range B13:E16. If we used the regular Paste command, the double line on the right side of the range E13:E16 would be replaced with a single line. Therefore, we are going to use one of the Paste Special commands to paste only the functions without any of the formatting treatments. This is accomplished through the following steps:

1. Highlight the range D13:D16 in the **Budget Detail** worksheet.
2. Use the Fill handle and fill across to E13:16
3. Click cell E13.
4. Click the down arrow below the Paste button in the Home tab of the Ribbon.
5. Click the Formulas option from the drop-down list of buttons (see Figure 2.26 "Paste Formulas Option").

Figure 2.26 "Paste Formulas Option" shows the list of buttons that appear when you click the down arrow below the Paste button in the Home tab of the Ribbon. One thing to note about these options is that you can preview them before you make a selection by dragging the mouse pointer over the options. As shown in the figure, when the mouse pointer is placed over the Formulas button, you can see how the functions will appear before making a selection. Notice that the double-line border does not change when this option is previewed. That is why this selection is made instead of the regular Paste option.

Figure 2.26 Paste Formulas Option

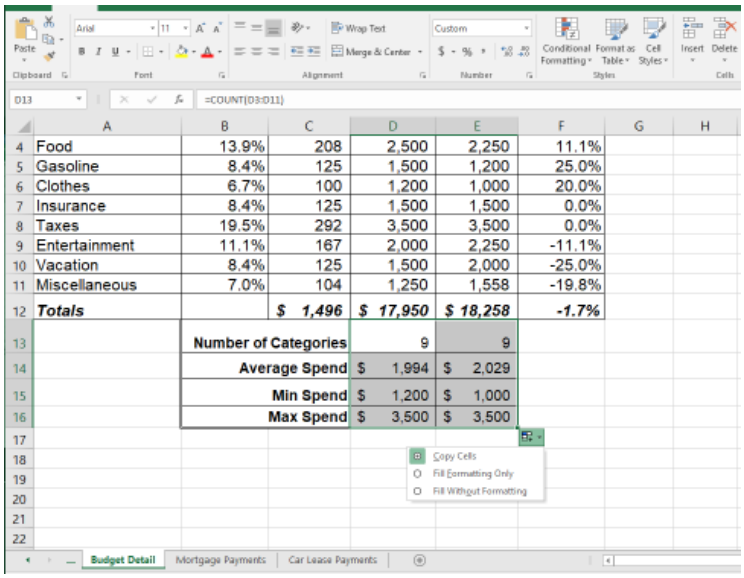

Click here to view the list of paste options.
The paste Formulas option
Use this option to paste only formulas and any number formats that have been applied to the output.
A preview of the function outputs appear in the range E13:E16 when the mouse pointer is dragged over the Formulas option.
Paste
Formulas (F)
Paste Values
Other Paste Options
Paste Special...
Budget Summary
Budget Detail
Mortgage Payments
Car Lease Payments

		Percent of Total	Monthly Spend	Annual Spend	LY Spend	Percent Change
	ities	16.7%	$ 250	$ 3,000	$ 3,000	0.0%
		13.9%	$ 208	$ 2,500	$ 2,250	11.1%
		8.4%	$ 125	$ 1,500	$ 1,200	25.0%
		6.7%	$ 100	$ 1,200	$ 1,000	20.0%
		8.4%	$ 125	$ 1,500	$ 1,500	0.0%
8	Taxes	19.5%	$ 292	$ 3,500	$ 3,500	0.0%
9	Entertainment	11.1%	$ 167	$ 2,000	$ 2,250	-11.1%
10	Vacation	8.4%	$ 125	$ 1,500	$ 2,000	-25.0%
11	Miscellaneous	7.0%	$ 104	$ 1,250	$ 1,558	-19.8%
12	***Totals***		***$ 1,496***	***$ 17,950***	***$ 18,258***	-1.7%
13		**Number of Categories**		9	9	
14		**Average Spend**		$ 1,994	$ 2,029	
15		**Min Spend**		$ 1,200	$ 1,000	
16		**Max Spend**		$ 3,500	$ 3,500	

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Alternatively, you can use the quick format button that appears when you copy the cells across using the auto fill handle.

Figure 2.26B *Paste Formulas Option with AutoFill*



	A	B	C	D	E	F
4	Food	13.9%	208	2,500	2,250	11.1%
5	Gasoline	8.4%	125	1,500	1,200	25.0%
6	Clothes	6.7%	100	1,200	1,000	20.0%
7	Insurance	8.4%	125	1,500	1,500	0.0%
8	Taxes	19.5%	292	3,500	3,500	0.0%
9	Entertainment	11.1%	167	2,000	2,250	-11.1%
10	Vacation	8.4%	125	1,500	2,000	-25.0%
11	Miscellaneous	7.0%	104	1,250	1,558	-19.8%
12	***Totals***		***$ 1,496***	***$ 17,950***	***$ 18,258***	***-1.7%***
13		**Number of Categories**		9	9	
14		**Average Spend**		$ 1,994	$ 2,029	
15		**Min Spend**		$ 1,200	$ 1,000	
16		**Max Spend**		$ 3,500	$ 3,500	

Skill Refresher – Paste Formulas

1. Click a cell location containing a formula or function.
2. Click the Copy button in the Home tab of the Ribbon.
3. Click the cell location or cell range where the formula or function will be pasted.
4. Click the down arrow below the Paste button in the Home tab of the Ribbon.
5. Click the Formulas button under the Paste group of buttons

Sorting Data (Multiple Levels)

Follow-along file: Continue with Excel Objective 2.00. (Use file Excel Objective 2.09 if starting here.)

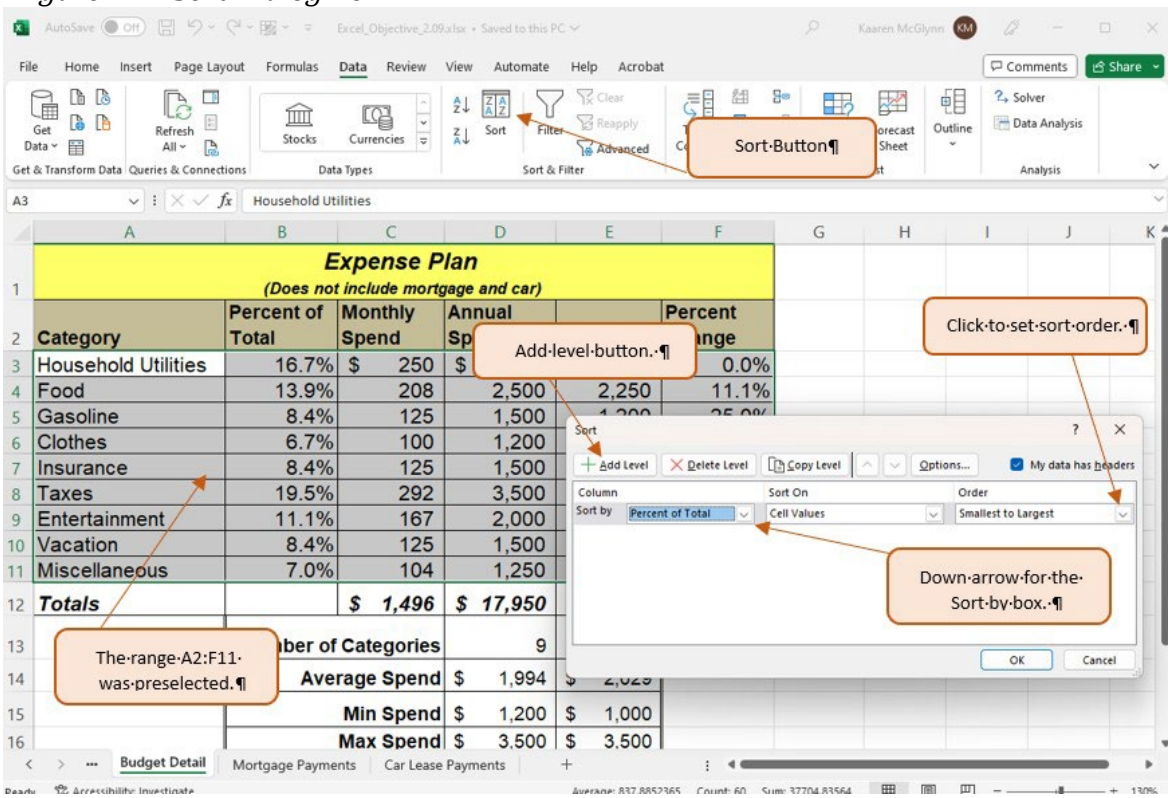
The **Budget Detail** worksheet shown in Figure 2.26 "Paste Formulas Option" is now producing several mathematical outputs through formulas and functions. The outputs allow you to analyze the details and identify trends as to how money is being budgeted and spent. Before we draw some conclusions from this worksheet, we will sort the data based on the Percent of Total column. As mentioned in Chapter 1 "Fundamental Skills", sorting is a powerful tool that enables you to analyze key trends in any data set. We demonstrated the process of executing a single-level sort in Chapter 1 "Fundamental Skills".

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

For the purposes of the **Budget Detail** worksheet, we need to set multiple levels for the sort order. This is accomplished through the following steps:

1. Highlight the range A2:F11 in the **Budget Detail** worksheet. (Important: if you do not have contiguous information in columns or row, you must highlight the data to be sorted before performing your sort.)
2. Click the Data tab in the Ribbon.
3. Click the Sort button in the Sort & Filter group of commands. This opens the Sort dialog box, as shown in Figure 2.27 "Sort Dialog Box".

Figure 2.27 Sort Dialog Box



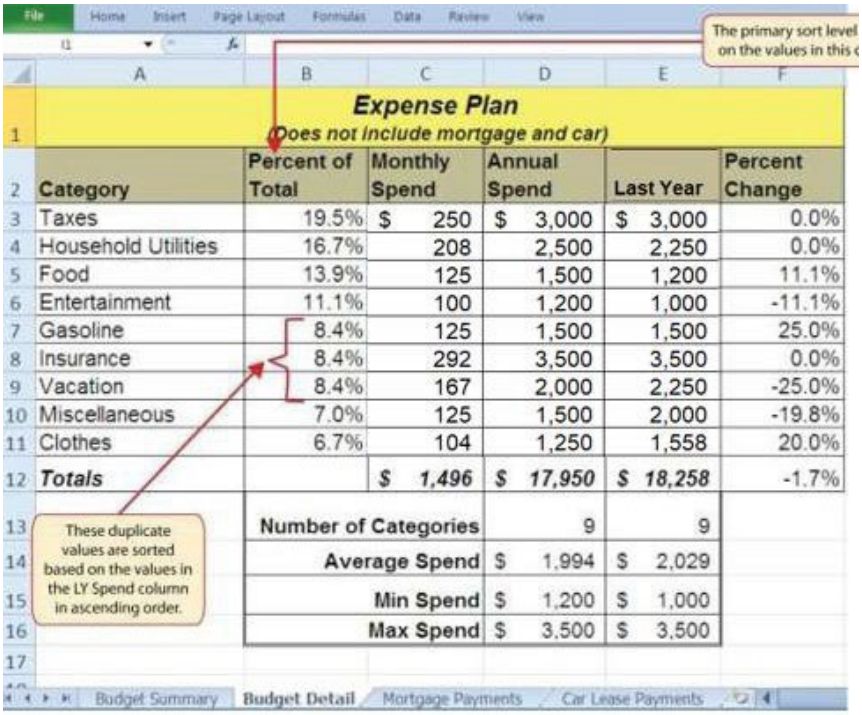
4. Click the down arrow next to the "Sort by" box.
5. Click the Percent of Total option from the drop-downlist.
6. Click the down arrow next to the sort Order box.
7. Click the Largest to Smallest option.
8. Click the Add Level button. This allows you to set a second level for any duplicate values in the Percent of Total column.
9. Click the down arrow next to the "Then by" box.
10. Select the Last Year option.
11. Click the OK button at the bottom of the Sort dialog box.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.28 "Budget Detail Worksheet after Sorting" shows the **Budget Detail** worksheet after it has been sorted. Notice that there are three identical values in the Percent of Total column. Therefore, a second sort level had to be created for this worksheet. The second sort level arranges the values of 8.4% based on the values in the LY Spend column in ascending order. Excel gives you the option to set as many sort levels as necessary for the data contained in a worksheet.

Figure 2.28 Budget Detail Worksheet after Sorting

Now that the **Budget Detail** worksheet is sorted, a few key trends can be easily identified.


The primary sort level
on the values in this
Expense Plan
(Does not include mortgage and car)
These duplicate values are sorted based on the values in the LY Spend column in ascending order.
Budget Summary
Budget Detail
Mortgage Payments
Car Lease Payments

Category	Percent of Total	Monthly Spend	Annual Spend	Last Year	Percent Change
Taxes	19.5%	$ 250	$ 3,000	$ 3,000	0.0%
Household Utilities	16.7%	208	2,500	2,250	0.0%
Food	13.9%	125	1,500	1,200	11.1%
Entertainment	11.1%	100	1,200	1,000	-11.1%
Gasoline	8.4%	125	1,500	1,500	25.0%
Insurance	8.4%	292	3,500	3,500	0.0%
Vacation	8.4%	167	2,000	2,250	-25.0%
Miscellaneous	7.0%	125	1,500	2,000	-19.8%
Clothes	6.7%	104	1,250	1,558	20.0%
Totals		***$ 1,496***	***$ 17,950***	***$ 18,258***	-1.7%
	Number of Categories		9	9	
	Average Spend		$ 1,994	$ 2,029	
	Min Spend		$ 1,200	$ 1,000	
	Max Spend		$ 3,500	$ 3,500	

The worksheet clearly shows that the top three categories as a percentage of total budgeted spending for the year are Taxes, Household Utilities, and Food. All three categories are necessities (or realities) of life and typically require a significant amount of income for most households. Looking at the Percent Change column, we can see how our planned spending is expected to change from last year. This is perhaps the most important column on the worksheet because it allows you to assess whether your plan is realistic. You will see that there are no changes planned for Taxes and Household Utilities. While Taxes can change from year to year, it is not too difficult to predict what they will be. In this case, we are assuming that there are no changes to the tax costs for our budget. We are also planning no change in Household Utilities. These costs can fluctuate from year to year as well. However, you can take measures to reduce costs, such as using less electricity, turning off heat when no one is in the house, keeping track of your cell's data usage so you do not go over the maximum allowed in your plan, and so on. As a result, there is no change in planned spending for Household Utilities because we will assume that any rate increases will be offset with a decrease in usage. The third item that is planned not to change is

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Insurance. Insurance policies for cars and homes can change, but as is true for taxes, the changes are predictable. Therefore, we are assuming no changes in our insurance policy.

The first big change that is noticeable in the worksheet is the Food and Entertainment categories in rows 5 and 6 (see definitions in Table 2.1 "Spend Category Definitions"). The Percent Change column indicates that there is an 11.1% decrease in Entertainment spending and an 11.1% increase in Food spending. This is logical because if you plan to eat in restaurants less frequently, you will be eating at home more frequently. Although this makes sense in theory, it may be hard to do in practice. Dinners and parties with friends may be tough to turn down. However, the entire process of maintaining a budget is based on discipline, and it certainly takes a significant amount of discipline to plan targets for yourself and stick to them.

A few other points to note are the changes in the Gasoline and Vacation categories. If you commute to school or work, the price of gas can have a significant impact on your budget. It is important to be realistic if gas prices are increasing, and you should reflect these increases in your budget. To compensate for the increased spending for gas, the spending plan for vacations has been reduced by 25%. Budgeting often requires a certain degree of creativity. Although the Vacation budget has been reduced, there is still money you can set aside to make plans for spring break or winter break.

Finally, the budget shows a decrease in Miscellaneous spending of 19.8%. This was defined as a group containing several expenses, such as textbooks, school supplies, software updates, and so on (see Table 2.1 "Spend Category Definitions"). You may be able to reduce your spending in this category if you can use items such as online textbooks. This reduction in spending can free up funds for Clothes, a spend category that has increased by 20%. We will continue to develop the Personal Budget workbook further in Section 2.3 "Functions for Personal Finance".

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Key Takeaways

Statistical functions are used when a mathematical process is required for a range of cells, such as

- Summing the values in several cell locations. For these computations, functions are preferable to formulas because adding many cell locations one at a time can be very time-consuming.
- Statistical functions can be created using cell ranges or selected cell locations separated by commas. Make sure you use a cell range (two cell locations separated by a colon) when applying a statistical function to a contiguous range of cells.
- Use dynamic arrays when creating formulas that will span a range but need a cell that will not change to get the correct results.
- A #SPILL error occurs when the range your formula is trying to spill already has other data in it. Remove the data that shouldn't be there to correct the error.
- To prevent Excel from changing the cell references in a formula or function when pasted to a new cell location, you must use an absolute reference. You can do this by placing a dollar sign ($) in front of the column letter and row number of a cell reference.
- The #DIV/0 error appears if you create a formula that attempts to divide a constant or the value in a cell reference by zero.
- The Paste Formulas option is used when you need to paste formulas without any formatting treatments into cell locations that have already been formatted.
- You need to set multiple levels, or columns, in the Sort dialog box when sorting data that contains several duplicate values.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

EXERCISES

1. Which of the following explains how data in a worksheet can be sorted if the primary column of data contains several duplicate values?
   a. You can only sort data based on the values in one column. Excel will take the duplicate values and sort them in the order in which they were entered the worksheet.
   b. Excel will sort any duplicate values in the primary column based on the values one column to the right in ascending order.
   c. You can click the Add button in the Sort dialog box and designate which column Excel should use to sort any duplicate values in the primary column.
   d. You would sort each column in the worksheet one at a time.
2. In the formula =C2/$C$24, the dollar signs used in the C24 cell reference indicate:
   a. Relative referencing has been turned off for this cell reference.
   b. Any value entered into cell C24 will be formatted with US currency.
   c. The output of the formula will be formatted with US currency.
   d. The value currently in C24 cannot be changed.
3. Which statement best explains how the following function will produce a result =AVERAGE(B1, B10)?
   a. The function will calculate the average for the values in B1 and B10.
   b. The function will calculate the average for the values in all cell locations in the range B1 through and including B10.
   c. Commas cannot be used in statistical functions. The function cannot produce an output and will display the #DIV/0 error code.
   d. The function will take the average of cell B1 based on the value that is entered into cell B10.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

2.4 Functions for Personal Finance

LEARNING OBJECTIVES
1. Understand the fundamentals of loans and leases.
2. Create and use named cells and ranges in functions.
3. Use the PMT function to calculate monthly mortgage payments on a house.
4. Use the PMT function to calculate monthly lease payments for an automobile.
5. Learn how to summarize data in a workbook by using worksheet links to create a summary worksheet.
6. Understand the concept of the time value of money.
7. Use the FV function to calculate the future value of personal investments.
8. Create amortization schedules and use the Sequence function.

In this section, we will discover the power of using named cells and ranges in our functions to better describe what is happening inside the function itself as we continue to develop the Personal Budget workbook.

Notable items that are missing from the **Budget Detail** worksheet are the payments you might make for a car or a home. In addition, you may want to set and track a savings goal. This section demonstrates Excel functions used to calculate lease payments for a car, to calculate mortgage payments for a house, and to project future savings based on regular contributions and an average rate of return. This section also discusses the scenario capabilities of Excel once the Personal Budget workbook is complete.

Before we continue with our Budget worksheet, we will explore how to name cells and ranges, modify them, rename them, or delete them.

Defining and using names in formulas

By using names, you can make your formulas much easier to understand and maintain. You can define a name for a cell, a range of cells, a function, a constant, or a table. Once you adopt the practice of using names in your workbook, you can easily update, audit, and manage these names.

A name is a meaningful shorthand that makes it easier to understand the purpose of a cell reference, constant, formula, or table, each of which may be difficult to comprehend at first

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

glance. The following information shows common examples of names and how they can improve clarity and understanding.

Example Type	Example with no name	Example using a name
Reference	=SUM(C20:C30)	=SUM(FirstQuarterSales)
Constant	=PRODUCT(A5,8.3)	=PRODUCT(Price,WASalesTax)
Formula	=SUM(XLOOKUP(A1,B1:F20,5,FALSE), -G5)	=SUM(XLOOKUP(Inventory_Level,-Order_Amt,FALSE) -G5
Range/or Table	=C4:G36	=TopSales06

Types of names

There are several types of names that you can create and use.

Defined name A name that represents a cell, range of cells, formula, or constant value. You can create your own defined name, and Microsoft Office Excel sometimes creates a defined name for you, such as when you set a print area.

Table name A name for an Excel table, which is a collection of data about a particular subject that is stored in records (rows) and fields (columns). We will be discussing Tables later.

The scope of a name

All names have a scope, either to a specific worksheet (also called the local worksheet level) or to the entire workbook (also called the global workbook level). The scope of a name is the location within which the name is recognized without qualification. For example:

- If you have defined a name, such as Budget_FY18, and its scope is Sheet1, that name, if not qualified, is recognized only in Sheet1, but not in other sheets without qualification.

To use a local worksheet name in another worksheet, you can qualify it by preceding it with the worksheet name, as the following example shows:

Sheet1! Budget_FY18

- If you have defined a name, such as Sales_Dept_Goals, and its scope is the workbook, that name is recognized for all worksheets in that workbook, but not for any other workbook.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

A name must always be unique within its scope. You can override the local worksheet level for all worksheets in the workbook, except for the first worksheet, which always uses the local name if there is a name conflict and cannot be overridden.

Defining and entering names

You define a name by using the:

- **Name box on the formula bar** This is best used for creating a workbook level name for a selected range.
- **Create a name from selection** You can conveniently create names from existing row and column labels by using a selection of cells in the worksheet.
- **New Name dialog box** This is best used for when you want more flexibility in creating names, such as specifying a local worksheet level scope or creating a name comment.

Note: By default, names use absolute cell references.

You can select named cells and ranges to use in your functions and formulas by:

- **Typing:** Typing the name, for example, as an argument to a formula.
- **Using Formula AutoComplete:** Use the Formula AutoComplete drop-down list, where valid names are automatically listed for you.
- **Selecting from the Use in Formula command:** Select a defined name from a list available from the **Use in Formula** command in the **Defined Names** group on the **Formulas** ribbon.

Pasting a defined names list:

You can also create a list of defined names in a workbook. Locate an area with two empty columns on the worksheet (the list will contain two columns, one for the name and one for a description of the name). Select a cell that will be the upper-left corner of the list. On the **Formulas** tab, in the **Defined Names** group, click **Use in Formula**, click **Paste Names** and then, in the **Paste Names** dialog box, click **Paste List**.

Naming Rules

The following is a list of naming rules that you need to be aware of when you create and edit names.

- **Valid characters:** The first character of a name must be a letter, an underscore character (_), or a backslash (\). Remaining characters in the name can be letters, numbers, periods, and underscore characters.

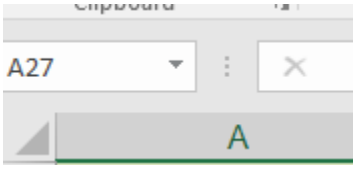
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Tip: You cannot use the uppercase and lowercase characters "C", "c", "R", or "r" as a defined name, because they are all used as shorthand for selecting a row or column for the currently selected cell when you enter them in a **Name** or **Go To** text box.

- **Cell references disallowed** Names cannot be the same as a cell reference, such as Z$100 or R1C1.
- **Spaces are not valid:** Spaces are not allowed as part of a name. Use the underscore character (_) and period (.) as word separators, such as, Sales_Tax or First.Quarter.
- **Name length** A name can contain up to 255 characters.
- **Case sensitivity** Names can contain uppercase and lowercase letters. Excel does not distinguish between uppercase and lowercase characters in names. For example, if you created the name Sales and then create another name called SALES in the same workbook, Excel prompts you to choose a unique name.

Define a name for a cell or cell range on a worksheet.

1. Select the cell, range of cells, or nonadjacent selections that you want to name.
2. Click the **Name** box at the left end of the formula bar.



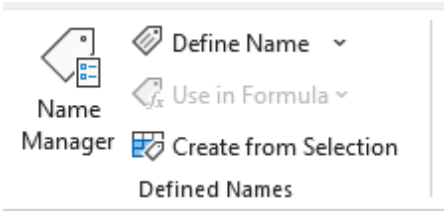
3. Type the name that you want to use to refer to your selection. Names can be up to 255 characters in length.
4. Press ENTER.

Note: You cannot name a cell while you are changing the contents of the cell.

Define a name by using a selection of cells in the worksheet.

You can convert existing row and column labels to names.

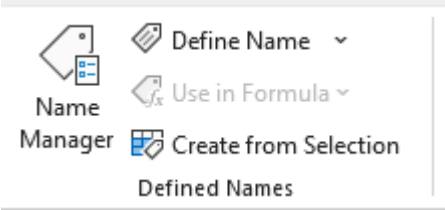
1. Select the range that you want to name, including the row or column labels.
2. On the **Formulas** tab, in the **Defined Names** group, click **Create from Selection**.



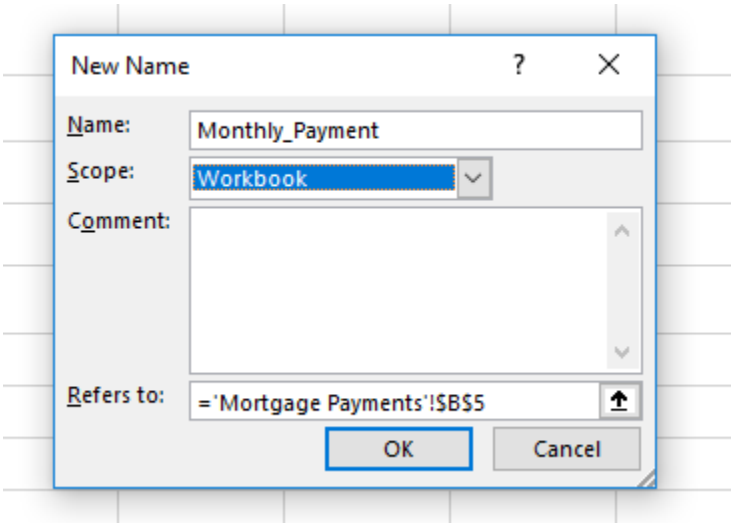
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

In the **Create Names from Selection** dialog box, designate the location that contains the labels by selecting the **Top row**, **Left column**, **Bottom row**, or **Right column** check box. A name created by using this procedure refers only to the cells that contain values and does not include the existing row and column labels.

Define a name by using the New Name dialog box.



1. On the **Formulas** tab, in the **Defined Names** group, click **Define Name**.
2. In the **New Name** dialog box, in the **Name** box, type the name that you want to use for your reference. *Note: Names can be up to 255 characters in length.*
3. To specify the scope of the name, in the **Scope** drop-down list box, select **Workbook**or the name of a worksheet in the workbook.



4. Optionally, in the **Comment** box, enter a descriptive comment up to 255 characters.
5. In the **Refers to** box, do one of the following:
   - To enter a cell reference, type the cell reference.
   - If a cell or range of cells has already been selected, you can leave it.
   - You can use the up arrow to the right of the" Refers to:" to verify your cell or range reference, or make a selection from the worksheet.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

- To enter a constant, type = (equal sign) and then type the constantvalue.
- To enter a formula, type = and then type the formula.

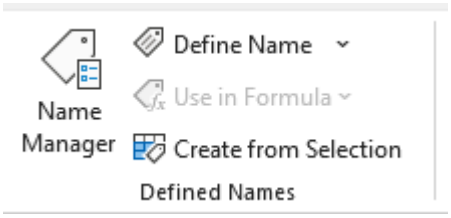
6. To finish and return to the worksheet, click **OK**.

Tip: To make the **New Name** dialog box wider or longer, click and drag the grip handle at the bottom.

Manage names by using the Name Manager dialog box

Use the **Name Manager** dialog box to work with the defined names and table names in the workbook. For example, you may want to find names with errors, confirm the value and reference of a name, view or edit descriptive comments, determine the scope, or delete a named range or cell. You can sort and filter the list of names, and easily add, change, or delete names from one location.

To open the **Name Manager** dialog box, on the **Formulas** tab, in the **Defined Names** group, click **Name Manager**.



View names

The **Name Manager** dialog box displays the following information about each name in a list box:

This Column:	Displays:
Icon and Name	One of the following: • A defined name, which is indicated by a defined nameicon. • A table name, which is indicated by a table nameicon.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

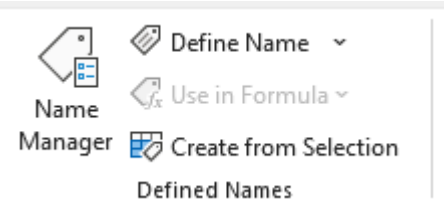
Value	The current value of the name, such as the results of a formula, a string constant, a cell range, an error, an array of values, or a placeholder if the formula cannot be evaluated. The following are representative examples: • "this is my string constant" • 3.1459 • {2003;12,2002; 23,2001,18} • #REF! • {...}
Refers To	The current reference for the name. The following are representative examples: • =Sheet1! $A$3 • =8.3 • =HR! $A$1: $Z$345 • =SUM(Sheet1! A1,Sheet2!B2)
Scope	• A worksheet name, if the scope is the local worksheet level. • "Workbook", if the scope is the global worksheet level.
Comment	Additional information about the name up to 255 characters. The following are representative examples: • This value will expire on May 2, 2007. • Don't delete! Critical name! • Based on the ISO certification exam numbers.

You cannot use the **Name Manager** dialog box while you are changing the contents of the cell but you can use the Use in Formula to select a named cell or range while in an active cell.

Change a name

If you change a defined name or table name in the Name Manager, all uses of that name in the workbook are also changed.

1. On the **Formulas** tab, in the **Defined Names** group, click **Name Manager**.



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

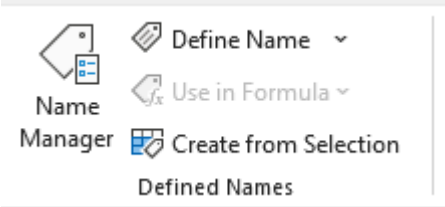
2. In the **Name Manager** dialog box, click the name that you want to change, and then click **Edit**.

Tip: You can also double-click the name.

3. In the **Edit Name** dialog box, in the **Name** box, type the new name for the reference.
4. In the **Refers to** box, change the reference, and then click **OK**.
5. In the **Name Manager** dialog box, in the **Refers to** box, change the cell, formula, or constant represented by the name.
    - To cancel unwanted or accidental changes, click Cancel, or press ESC.
    - To save changes, click **Commit**, or press ENTER.

The **Close** button only closes the **Name Manager** dialog box. It is not required to commit changes that have already been made.

Delete one or more names



2. On the **Formulas** tab, in the **Defined Names** group, click **Name Manager**.
3. In the **Name Manager** dialog box, click the name that you want to change.
4. Select one or more names by doing one of the following:
    - To select a name, click it.
    - To select more than one name in a contiguous group, click and drag the names, or press SHIFT and click the mouse button for each name in the group.
    - To select more than one name in a noncontiguous group, press CTRL and click the mouse button for each name in the group.
5. Click **Delete**. You can also press DELETE.
6. Click **OK** to confirm the deletion.

The **Close** button only closes the **Name Manager** dialog box. It is not required to commit changes that have already been made.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

The Fundamentals of Loans and Leases

Follow-along file: Continue with Excel Objective 2.00. (Use file Excel Objective 2.10 if starting here.)

One of the functions we will add to the Personal Budget workbook is the PMT function. This function calculates the payments required for a loan or a lease. However, before demonstrating this function, it is important to cover a few fundamental concepts on loans and leases.

Table 2.5 Key Terms for Loans and Leases

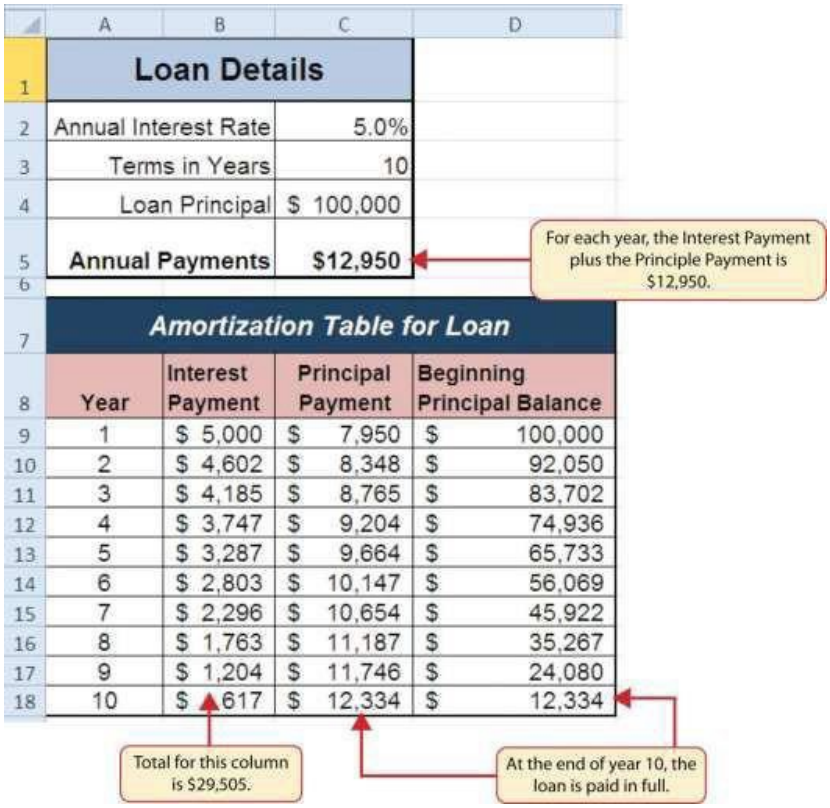
Term	Definition
Collateral	Any item of value that is used to secure a loan to ensure payments to the lender
Down Payment	The amount of cash paid toward the purchase of a house. If you are paying 20% down, you are paying 20% of the cost of the house in cash and are borrowing the rest from a lender.
Interest Rate	The interest that is charged to the borrower as a cost for borrowing money
Mortgage	A loan where property is put up for collateral
Residual Value	The interest that is charged to the borrower as a cost for borrowing money
Principal	The amount of money that has been borrowed
Terms	The amount of time you have to repay a loan

Figure 2.29 "Example of an Amortization Table" shows an example of an amortization table for a loan. A lender is required by law to provide borrowers with an amortization table when a loan contract is offered. The table in the figure shows how the payments of a loan would work if you borrowed $100,000 from a lender and agreed to pay it back over 10 years at an interest rate of 5%. You will notice that each time you make a payment, you are paying the bank an interest fee plus some of the loan principal. Each year the amount of interest paid to the bank decreases and the amount of money used to pay off the principal increases. This is because the bank is charging you interest on the amount of principal that has not been paid. As you pay off the principal, the interest rate is applied to a lower number, which reduces your interest charges. Finally, the figure shows that the sum of the values in the Interest Payment column is $29,505. This is how much it costs you to borrow this money over 10 years. Indeed, borrowing money is not free. It is important to note that

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

to simplify this example, the payments were calculated on an annual basis. However, most loan payments are made monthly.

Figure 2.29 Example of an Amortization Table



Loan Details	
Annual Interest Rate	5.0%
Terms in Years	10
Loan Principal	$ 100,000
Annual Payments	**$12,950**

For each year, the Interest Payment plus the Principle Payment is $12,950.

Amortization Table for Loan

Year	Interest Payment	Principal Payment	Beginning Principal Balance
1	$ 5,000	$ 7,950	$ 100,000
2	$ 4,602	$ 8,348	$ 92,050
3	$ 4,185	$ 8,765	$ 83,702
4	$ 3,747	$ 9,204	$ 74,936
5	$ 3,287	$ 9,664	$ 65,733
6	$ 2,803	$ 10,147	$ 56,069
7	$ 2,296	$ 10,654	$ 45,922
8	$ 1,763	$ 11,187	$ 35,267
9	$ 1,204	$ 11,746	$ 24,080
10	$ 617	$ 12,334	$ 12,334

Total for this column is $29,505.

At the end of year 10, the loan is paid in full.

A lease is a contract in which you, the lessee, use an asset such as a car or a piece of equipment and you agree to make regular payments to the owner or the lessor. When you lease a car, the manufacturer or a leasing company retains ownership of the vehicle and you agree to make regular payments for a specific period of time. The amount of money you pay depends on the price of the car, the terms of the lease contract, and the car's expected residual value at the end of the lease.

The calculation of lease payments is like the calculation of loan payments. However, when you lease a car, you pay only the value of the car that is used. For example, suppose you are leasing a car that is priced at $25,000. The lease contract is for 4 years at an interest rate of 5%. The residual value of the car is $10,000. This means the car will lose $15,000 of its value over 4 years. Another way to state this is that the car will depreciate $15,000. A lease will be structured so that you pay this $15,000 in depreciation. However, the interest charges will be based on the purchase price of $25,000. We will look at a demonstration of leasing a car as well as buying a home in the next section.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

The PMT (Payment) Function for Loans

Follow-along file: Continue with Excel Objective 2.00. (Use file Excel Objective 2.10 if starting here.)

If you own a home, your mortgage payments are a major component of your household budget. If you are planning to buy a home, having a clear understanding of your monthly payments is critical for maintaining strong financial health. In Excel, mortgage payments are conveniently calculated through the PMT (payment) function. This function is more complex than the statistical functions covered in Section 2.2 "Statistical Functions". With statistical functions, you are required to add only a range of cells or selected cells within the parentheses of the function. With the PMT function, you must accurately define a series of arguments for the function to produce a reliable output. Table 2.6 "Arguments for the PMT Function" lists the arguments for the PMT function. It is helpful to review the key loan and lease terms in Table 2.5 "Key Terms for Loans and Leases" before reviewing the PMT function arguments. The PMT function is:

=PMT (RATE,NPER,PV,[FV],[Type])

Table 2.6 Arguments for the PMT Function

Argument	Definition
Rate	This is the interest rate the lender is charging the borrower. The interest rate is usually quoted in annual terms, so you must divide this rate by the number of payments per year.
Nper	The argument letters stand for *number of periods*. This is the term of the loan, which is the amount of time you have to repay the bank. This is usually quoted in years, so you must multiply the years by number of payments per year.
Pv	The argument letters stand for *present value*. This is the principal of the loan or the amount of money that is borrowed. When defining this argument, a minus sign must precede the cell location or value. For leases, this argument is used for the price of the item being leased.
[Fv]	The argument letters stand for *future value*. The brackets around the argument indicate that it is not always necessary to define it. It is used if there is a lump-sum payment that will be made at the end of the loan terms. This is also used for the residual value of a lease. If it is not defined, Excel will assume that it is zero.
[Type]	This argument can be defined with either a 1 or a 0. The number 1 is used if payments are made at the beginning of each period. A 0 is used if payments are made at the end of each period. The argument is in brackets because it does not have to be defined if payments are made at the end of each period. Excel assumes that this argument is 0 if it is not defined.

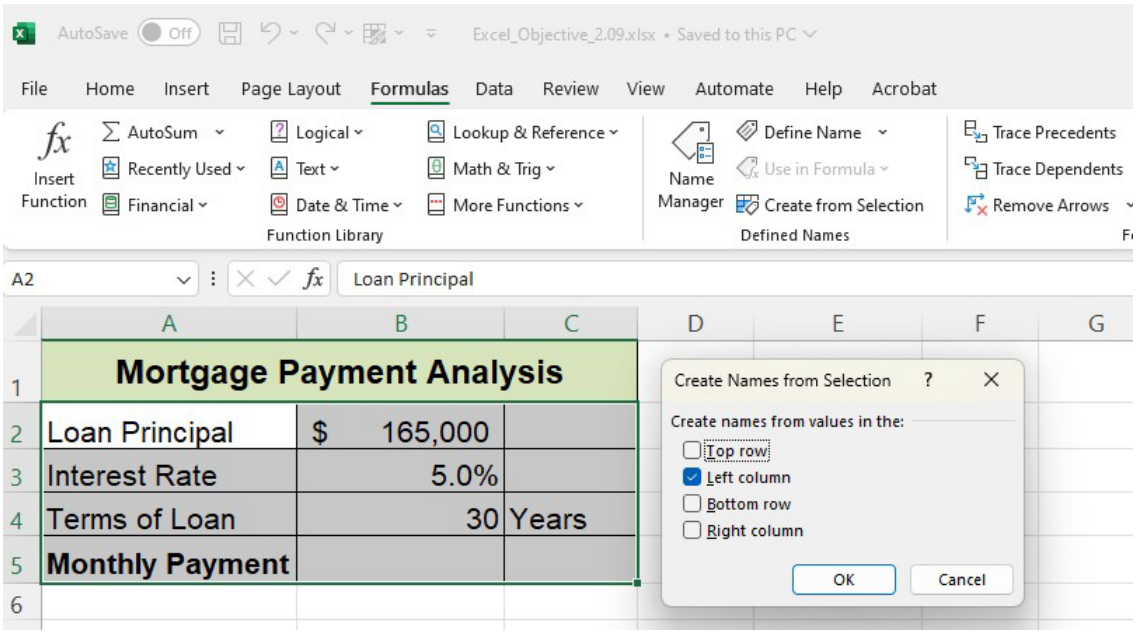
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

We will use the PMT function in the Personal Budget workbook to calculate the monthly mortgage payments for a house. These calculations will be made in the Mortgage Payments worksheet and then displayed in the Budget Summary worksheet through a named cell reference link.

The first thing we will do in this worksheet is name the cells we will be using in our functions. Next, we will discover a new method of adding functions to a worksheet. The following steps explain the new method using the Insert Function command for adding the PMT function:

1. Click the **Mortgage Payments** worksheet tab.
2. Highlight the range A2:B6. On the Formula ribbon, Defined Names section click on Create from Selection. Make sure Left Column is checked. (see Figure 2.29b "Create from Selection"). Click OK. You have now named all of the cells in the B column. (You can verify your named cells by using the drop-down arrow in the Name Box.)

Figure 2.29b Create from Selection

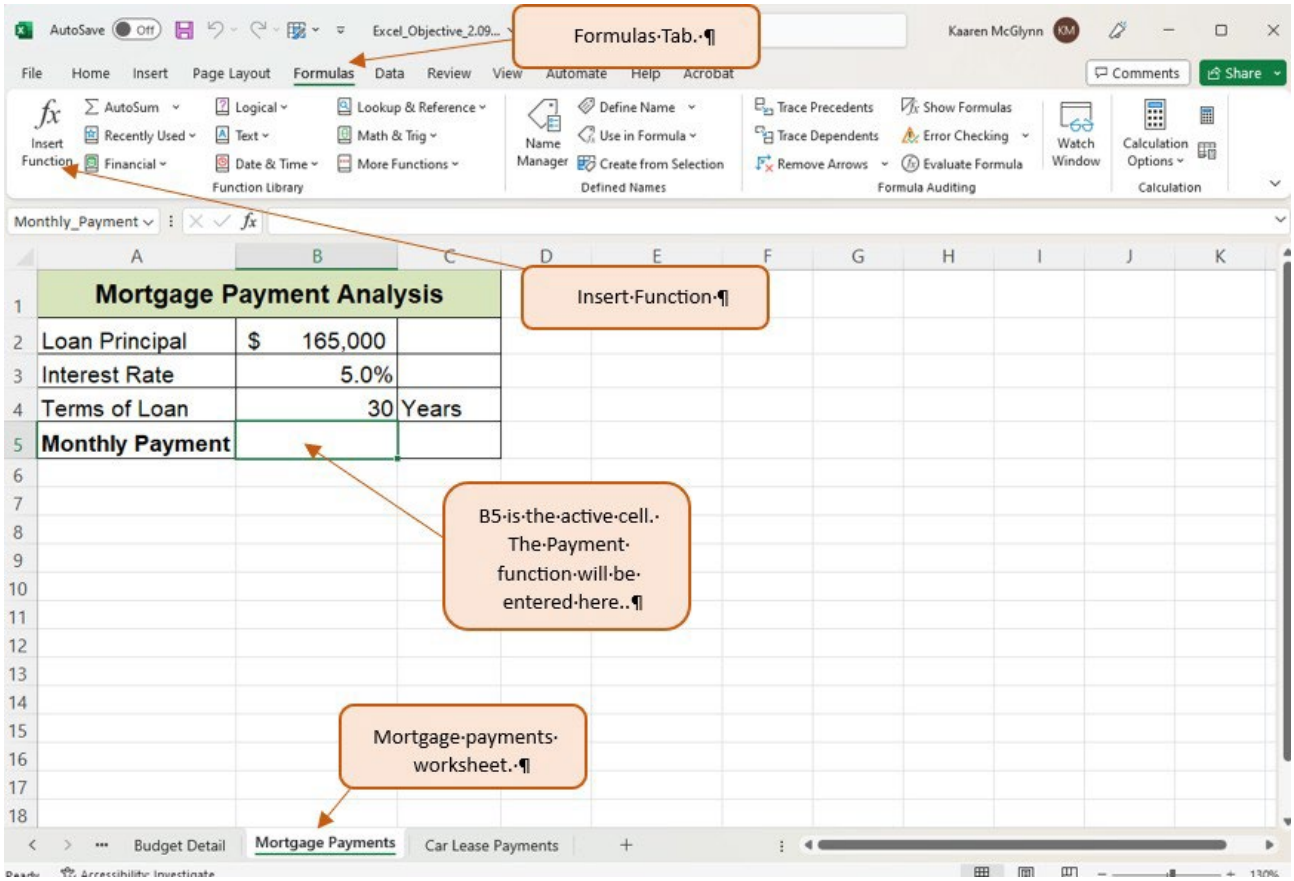


3. Click cell B5.
4. Click the Formulas tab on the Ribbon.
5. Click the Insert Function button (see Figure 2.30 "Mortgage Payments Worksheet"). This opens the Insert Function dialog box, which can be used for searching all functions in Excel.
6. In the "Search for a function:" input box at the top of the Insert Function dialog box, type payment (see Figure 2.31 "Insert Function Dialog Box"). Note that the current description in the "Search for a function:" input box will already be highlighted. You can begin typing and the description will be replaced with your entry.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

7. Click the Go button in the upper right side of the Insert Function dialog box. This adds all the Excel functions that match your description in the “Select a function:” box in the lower half of the Insert Function dialog box (see Figure 2.31 "Insert Function Dialog Box").
8. Click the PMT option in the “Select a function:” box in the lower half of the Insert Function dialog box.
9. Click the OK button at the lower right side of the Insert Function dialog box. This will open the Function Arguments dialog box.

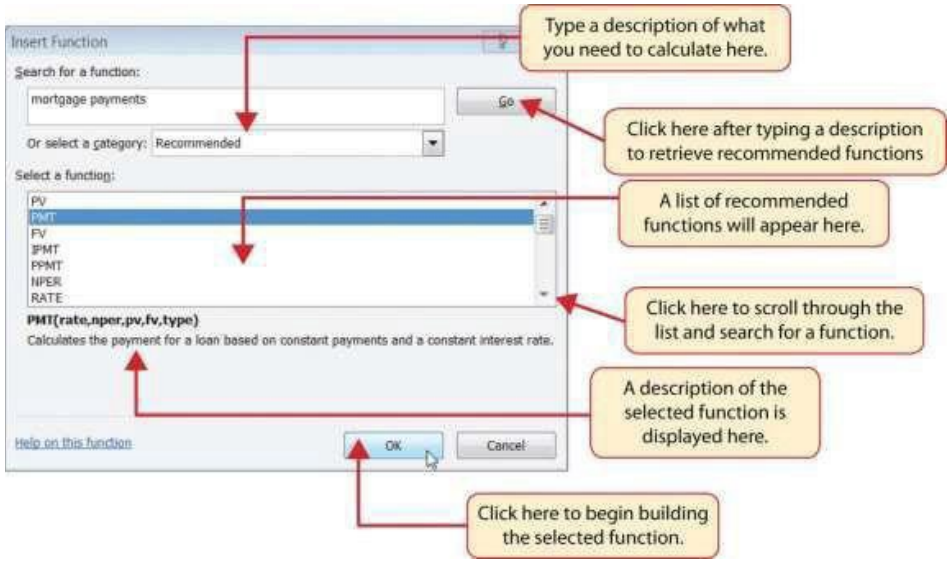
Figure 2.30 Mortgage Payments Worksheet



.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.31 Insert Function Dialog Box


Insert Function
Search for a function:
mortgage payments
Go
Or select a category: Recommended
Select a function:
PV
PMT
FV
IPMT
PPMT
NPER
RATE
PMT(rate,nper,pv,fv,type)
Calculates the payment for a loan based on constant payments and a constant interest rate.
Help on this function
OK
Cancel
Type a description of what you need to calculate here.
Click here after typing a description to retrieve recommended functions
A list of recommended functions will appear here.
Click here to scroll through the list and search for a function.
A description of the selected function is displayed here.
Click here to begin building the selected function.

Keyboard Shortcuts – Insert Function
o Hold the SHIFT key while pressing the F3key.

10. The cursor automatically starts in the Rate box. This will be the first argument defined for the PMT function.

11. Click cell B3 on the worksheet. This is the rate being charged on the loan. You will see your defined name Interest_Rate appear in the Rate argument box.

12. Type a forward slash (/) for division.

13. Click on cell B5. Since our goal is to calculate the monthly payments for the loan, we need to divide the rate, which is stated in annual terms, by the number of payments per year. The number of payments per year is found in cell B5. This converts the annual rate to a monthly rate. (periodic rate) Your defined name Payments_per_Year will appear after your /.

14. Click in the Nper field in the Function Arguments dialog box. This is the second argument we define in the function. Nper is the total number of payments to be made over the life of the loan. It is the loan in years * the payments peryear.

15. Click cell B4 on the worksheet. This is the term or the amount of time we have to repay the loan. You will see the defined name Terms_of_Loan appears in your Nper argument box.

16. Type an asterisk (*) for multiplication.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

17. Click on cell B5. Since our goal is to calculate the total number of payments for the loan, we need to multiply the term of the loan by payments per year.

18. Click in the Pv argument field in the Function Arguments dialog box. This is the third argument we will define in the function.

19. Type a minus sign (−). When defining the Pv argument of the PMT function, any cell location or value must be preceded with a minus sign.

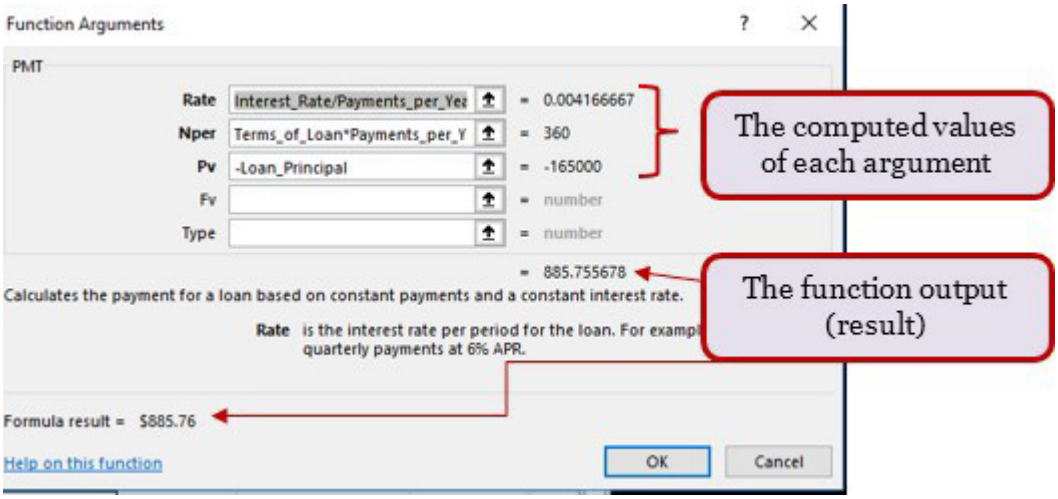
20. Click cell B2 on the worksheet. This is the principal of the loan. Your defined name Loan_Principal will appear in the PV argument field.

21. You will now see the Rate, Nper, and Pv arguments defined for the function.

22. Click the OK button at the bottom of the Function Arguments dialog box. The function will now be placed into the worksheet. Since we are not paying any lump sums of money at the end of the loan, there is no need to define the FV argument. Also, we will assume that the monthly mortgage payments will be made at the end of each month. Therefore, there is no need to define the Type argument.

Figure 2.32 "Function Arguments Dialog Box for the PMT Function" shows the completed Function Arguments dialog box for the PMT function. Notice that the dialog box shows the values for the Rate and Nper arguments. The Rate is divided by 12 to convert the annual interest rate to a monthly interest rate. The Nper argument is multiplied by 12 to convert the terms of the loan from years to months. Finally, the dialog box provides you with a definition for each argument. The definition appears when you click in the input box for the argument.

Figure 2.32 Function Arguments Dialog Box for the PMT Function



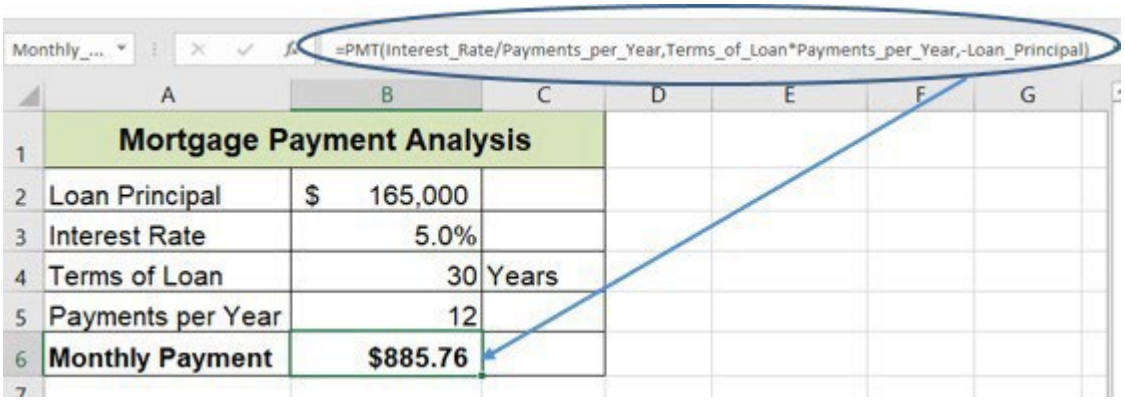
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Integrity Check - Comparable Arguments for PMT and FV Functions
When using functions such as PMT or FV, make sure the arguments are defined in comparable terms. For example, if you are calculating the monthly payments of a loan, make sure both the Rate and Nper argument are expressed in terms of payments per year. The function will produce an erroneous result if one argument is expressed in years while the other is expressed in months.

Integrity Check – Do the results of your financial functions make sense?
Evaluate the results of your PMT or other financial functions to determine if the result makes sense. If you purchase a $30,000 car over 5 years at 6% and the result of the PMT function comes out to be $7,000 per month you have an error in your function. **Do a reasonable test**. Does the PMT make sense based on the loan amount, interest rate, and the length of time in the loan.

Figure 2.33 "Mortgage Payments Worksheet with the PMT Function" shows the final appearance of the **Mortgage Payments** worksheet after the PMT function is added. The result of the function in cell B6 will be displayed in the **Budget Summary** worksheet.

Figure 2.33 Mortgage Payments Worksheet with the PMT Function



The PMT (Payment) Function for Leases

Follow-along file: Continue with Excel Objective 2.00. (Use file Excel Objective 2.11 if starting here.)

In addition to calculating the mortgage payments for a home, the PMT function will be used in the Personal Budget workbook to calculate the lease payments for a car. The details for the lease payments are found in the **Car Lease Payments** worksheet. Like the statistical functions, we can type the PMT function directly into a cell. However, you must know the definitions for each argument of the function and understand how these arguments need to

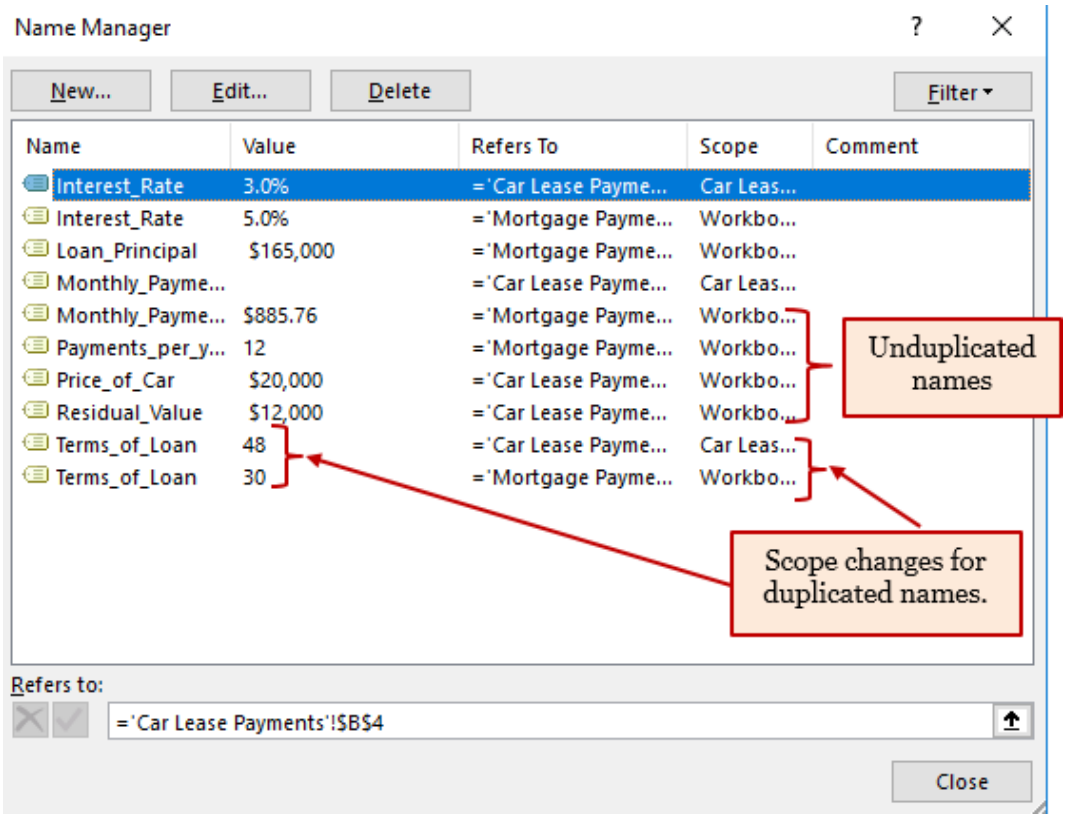
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

be defined based on your objective. The terms for loans and leases are in Table 2.5 "Key Terms for Loans and Leases", and the definitions for the arguments of the PMT function are in Table 2.6 "Arguments for the PMT Function". The following steps explain how the PMT function is added to the Personal Budget workbook to calculate the lease payments for a car:

1. Highlight the range A2:B6. On the Formula ribbon, Defined Names section clickon Create from Selection. Make sure the Left Column is checked. (see Figure 2.29b "Create from Selection"). Click OK. You have now named all the cells in the B column. (You can verify your named cells by using the drop-down arrow in the Name Box.)

Note: When we use the same names on two different worksheets, the Name Manager assigns a different scope. The first time we named Interest rate the scope was for the Mortgage Payments worksheet. This time it is for the Car Lease Payments worksheet. See Figure 2.33a.

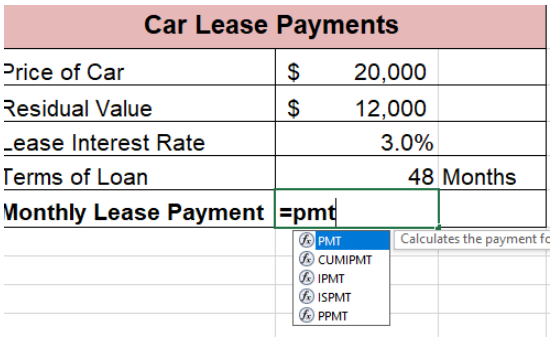
Figure 2.33a *Name Manager Named Functions*.



2. Click cell B6 in the Car Lease Payments worksheet.
3. Type an equal sign (=).

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

4. Type the letters PMT. A drop-down list of Excel functions will appear. Double click on the PMT



5. Click cell B4. This is the interest rate being charged for the lease.
6. Type the forward slash (/) for division.
7. Type the number 12. Since our goal is to calculate the monthly lease payments, we divide the interest rate by 12 to convert the annual rate to a monthly rate.
8. Type a comma. When you type a function containing arguments, you must separate each argument with a comma. This signals to Excel that one argument has been defined and you are ready to define the next argument in the function.
9. Click cell B5. This is the term or the length of time for the lease contract. Since the term is already expressed in months, we can just reference cell B5 and move to the next argument.
10. Type a comma. This advances the function to the Pv argument.
11. Type a minus sign (–). Remember that cell locations or values used to define the Pv argument must be preceded with a minus sign.
12. Click cell B2 on the worksheet, which is the price of the car.
13. Type a comma. This advances the function to the [Fv] argument.
14. Click cell B3 on the worksheet. This is the residual value of the car. Note that cell location and values used to define the [Fv] argument are NOT preceded by a minus sign.
15. Type a comma. This advances the function to the [Type] argument.
16. Type the number 1. We will assume that the lease payments will be due at the beginning of each month.
17. Type a closing parenthesis")".
18. Press the ENTER key.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

19. Figure 2.34 "PMT Function Constructed to Calculate Lease Payments" shows how the PMT function should appear before pressing the ENTER key. Notice the commas that separate each argument of the function. Also, the tip box will show the current argument being defined in bold font.

Figure 2.34 PMT Function Constructed to Calculate Lease Payments

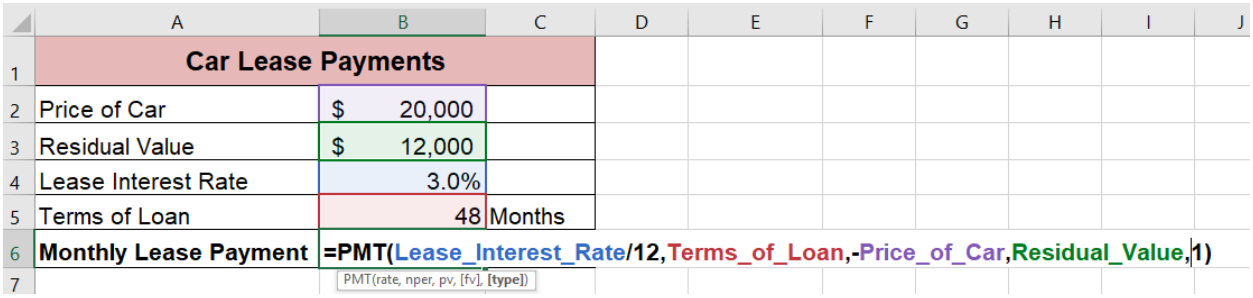
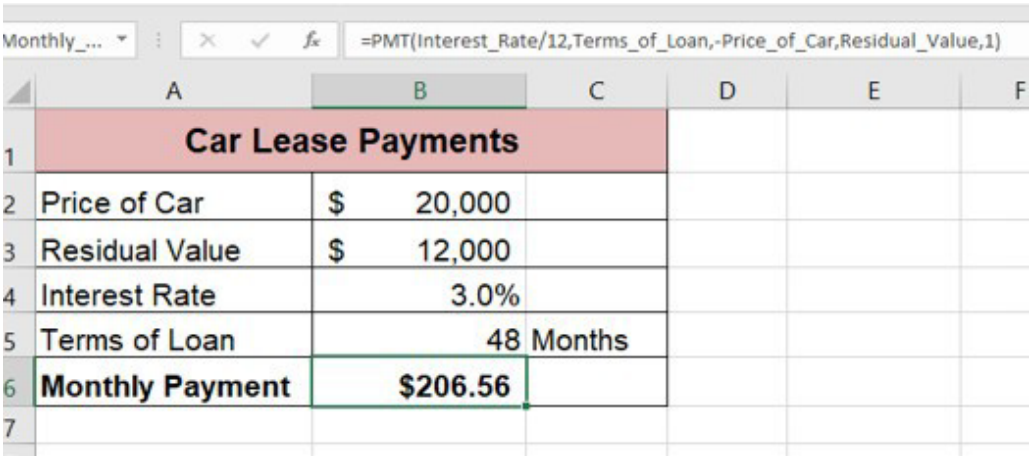

Car Lease Payments
Price of Car $ 20,000
Residual Value $ 12,000
Lease Interest Rate 3.0%
Terms of Loan 48 Months
Monthly Lease Payment =PMT(Lease_Interest_Rate/12,Terms_of_Loan,-Price_of_Car,Residual_Value,1)
PMT(rate, nper, pv, [fv], [type])

Figure 2.35 "Results of the PMT Function in the Car Lease Payments Worksheet" shows the result of the PMT function. The monthly payments for this lease are $206.56. This monthly payment will be displayed in the **Budget Summary** worksheet.

Figure 2.35 Results of the PMT Function in the Car Lease Payments Worksheet



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Skill Refresher – PMT Function

1. Name your cells and ranges and use them in your function.
2. Type an equal sign (**=**).
3. Type the letters **PMT** followed by an open parenthesis or double click the function name from the function list.
4. Define the Rate argument with a cell location that contains the rate being charged by the lender for the loan or lease.
5. Define the Nper argument with a cell location that contains the amount of time to repay the loan or lease.
6. Define the Pv argument with a cell location that contains the principal of the loan, or the price of the item being leased. Cell locations or values used for this argument must be preceded by a minus sign.
7. Define the [Fv] argument with a cell location that contains the residual value of the item being leased or the lump sum payment for a loan.
8. Define the [Type] argument with a 1 if payments are made at the beginning of each period or 0 if payments are made at the end of each period.
9. Type a closing parenthesis **)**.
10. Press the ENTER key.

Creating an Amortization Schedule for a Loan

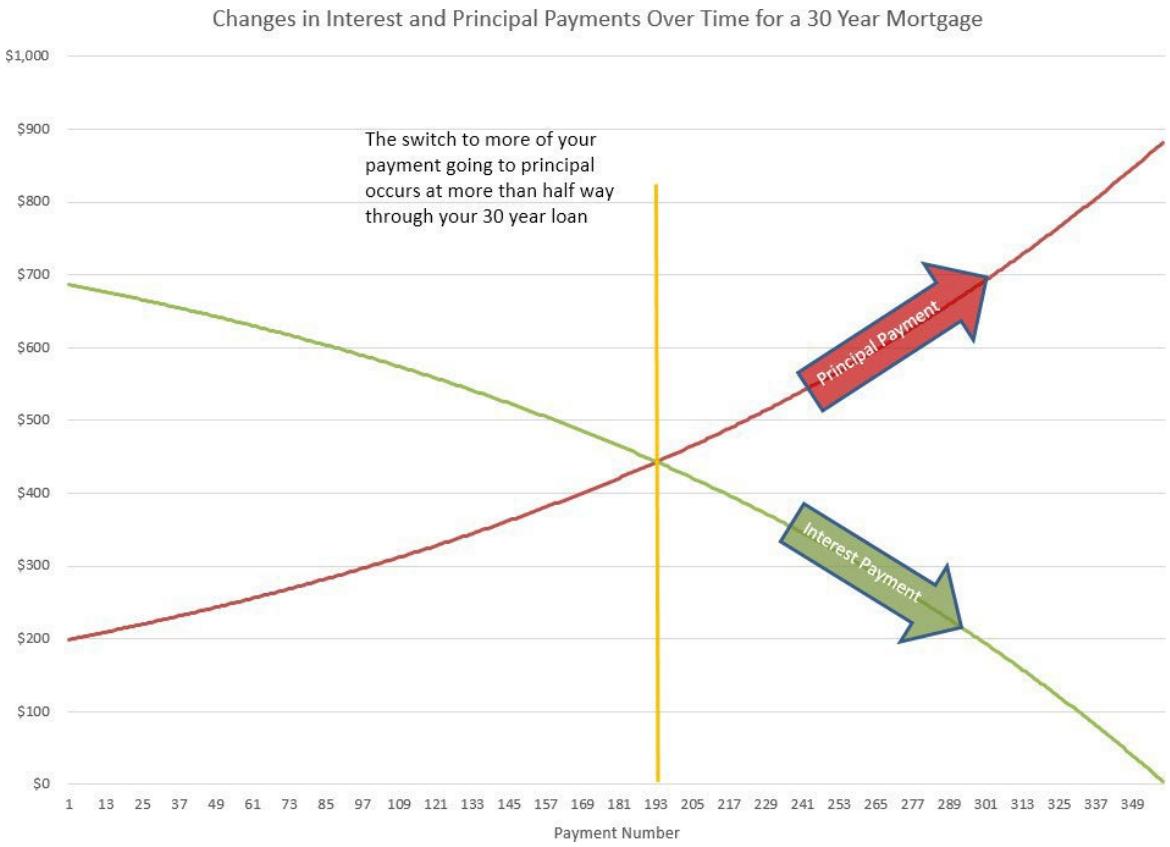
Follow-along file: Continue with Excel Objective 2.00. (Use file Excel Objective 2.11b if starting here.)

Now that we have determined how much a loan or lease will cost per month, it is useful to determine how interest and principal will be applied from our payment each month. Figure 2.35b shows how interest and principal on a loan behave over time. You can see from this chart that it will take you over 16 years for your payments to go more toward principal than interest.

One of the advantages of preparing an amortization schedule is that you can see exactly how much is applied to principal and interest each time you make a payment. You can also play with the monthly payment amount and see how increasing your payment will apply more to your principal payment while reducing your loan duration.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.35b Changes in Principal and Interest over the life of a loan


Changes in Interest and Principal Payments Over Time for a 30 Year Mortgage
$1,000
$900
$800
$700
$600
$500
$400
$300
$200
$100
$0
The switch to more of your payment going to principal occurs at more than half way through your 30 year loan
Principal Payment
Interest Payment
1 13 25 37 49 61 73 85 97 109 121 133 145 157 169 181 193 205 217 229 241 253 265 277 289 301 313 325 337 349
Payment Number

Before starting the amortization schedule we will learn about the dynamic function SEQUENCE. This function is covered in more depth in Chapter 6.

SEQUENCE

The SEQUENCE function in Excel will generate a list of sequential numbers in an array format. It is helpful when dealing with many rows or columns that need sequential numbers or dates. It can also generate numbers in incremental values and from high to low. This function is available in Excel for Microsoft 365, Excel 2021, and Excel for the web. Legacy versions of Excel do not have this functionality.

One of the great features of the SEQUENCE function is the ability to tie the arguments to a function. We will do that in creating the years in the amortization schedule.

The syntax of the SEQUENCE function is:

=SEQUENCE(rows, [columns], [start], [step]) where:

- **rows**: **Required**. The number of rows to return. This is the only required argument. The others are optional based on the results needed.
- **columns**: Optional. The number of columns to return. Defaults to 1 if omitted.
- **start**: Optional. The first number in the sequence. Defaults to 1 if omitted.
- **step**: Optional. The increment for each subsequent value. Defaults to 1 if omitted.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

To complete the amortization schedule, we will use two financial functions: the PPMT. The Principal Payment function calculates the amount of any given period's principal payment, and the IPMT Interest Payment function calculates the interest taken from any given period payment.

The PPMT and the IPMT have the same arguments and are the same as the PMT with one exception. The exception is that you must tell the function which period you are calculating out the interest or principal.

The arguments in both functions are:

RATE, **Current period**, NPER, PV

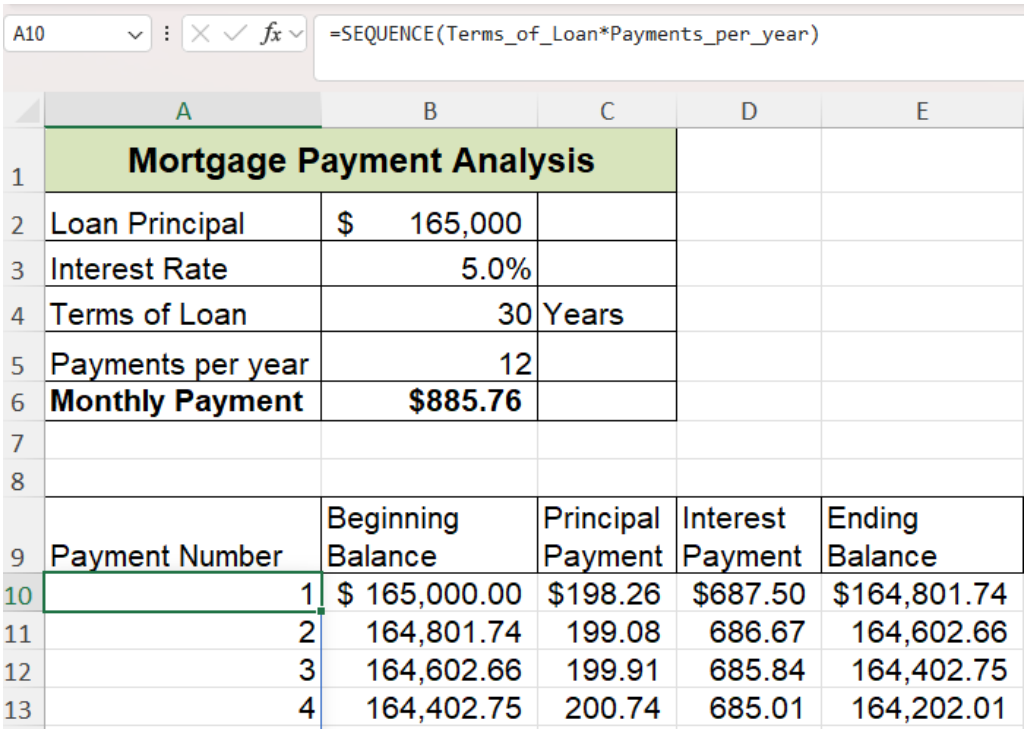
- Where RATE = the periodic interest rate (RATE/payments per year)
- Current period = the current period number
- NPER = total payments over the life of the loan
- PV = the original amount of the loan

Let's set up an amortization schedule. Complete the following steps:

1. On the Mortgage Payments worksheet enter the following column headers:
    a. Cell A9: Payment Number
    b. Cell B9: Beginning Balance
    c. Cell C9: Principal Payment
    d. Cell D9: Interest Payment
    e. Cell E9: Ending Balance
2. Highlight cells B9:C9 and Wrap Text. Increase columns to letters in words stay together.
3. Highlight cells A9:E9 and apply an All Borders style from the Font section of the Home ribbon.
4. In cell A10 enter the number 1
5. In cell A11 enter the number 2
6. In cell A10, use the SEQUENCE function to insert the years that the loan will require to pay it off. . Our SEQUENCE function will use the formula =SEQUENCE(**Terms_of_Loan * Payments per year)**. Non-named cell references will also work because of the dynamic array functionality. We are using these cell references rather than just the number 360 because if the terms of the loan change, our SEQUENCE function will automatically adjust for the change in loan terms. **Because this is a dynamic array function, the cells below the function cell must be empty or you will get a #SPILL error**.

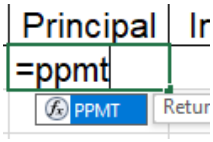
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.35b Sequence Function using named cells.



	A	B	C	D	E
1	**Mortgage Payment Analysis**				
2	Loan Principal	$ 165,000			
3	Interest Rate	5.0%			
4	Terms of Loan	30	Years		
5	Payments per year	12			
6	**Monthly Payment**	**$885.76**			
7					
8					
9	Payment Number	Beginning Balance	Principal Payment	Interest Payment	Ending Balance
10	1	$ 165,000.00	$198.26	$687.50	$164,801.74
11	2	164,801.74	199.08	686.67	164,602.66
12	3	164,602.66	199.91	685.84	164,402.75
13	4	164,402.75	200.74	685.01	164,202.01

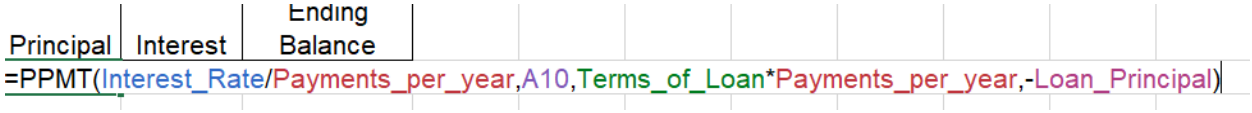
7. In cell B10 enter: = and click on the Loan principal in cell B2.
8. In cell C10 enter the PPMT function =PPMT, then double click on the function in the box below the cell



9. To complete the function
    a. Click on cell B3 (Interest Rate) enter the / to divide the rate, click on B5 (Payment per year).
    b. Enter a comma to separate the arguments.
    c. Click on cell A10 to enter the current period, enter a comma,
    d. Click on cell B4 to enter the Term of the loan, enter an * to multiply the term by the payments per year in cell B5.
    e. Enter a – minus sign and then click on B2 for the Loan Principal amount.
    f. Close your PPMT function with a closing). Figure 2.35c shows the arguments after they have been entered into the function. (The cells were already named in this worksheet.)-

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.35 PPMT function arguments



10. In cell D10 inter the IPMT function using the steps for the PPMT above, except you will type the IPMT instead of PPMT.
11. In cell E10 subtract the principal payment in cell C10 from the beginning balance in cell B10. =B10-C10
12. In cell B11 enter = and click on the ending balance in cell E10.
13. Highlight the range C10:E10 and copy down one row. (Using the fill handle makes this easy.)
14. Highlight the cells B11:E11 and use the fill handle to fill the formulas down through the 360th payment. You can do this quickly by double clicking the fill handle in the lower right corner of your highlighted area border. The balance in the last cell should = 0.

Figure 2.35b *Completed Amortization Schedule*

	A	B	C	D	E
1	**Mortgage Payment Analysis**				
2	Loan Principal	$ 165,000			
3	Interest Rate	5.0%			
4	Terms of Loan	30	Years		
5	Payments per year	12			
6	**Monthly Payment**	**$885.76**			
7					
8					
9	Payment Number	Beginning Balance	Principal Payment	Interest Payment	Ending Balance
10	1	$ 165,000.00	$198.26	$687.50	$164,801.74
11	2	164,801.74	199.08	686.67	164,602.66
12	3	164,602.66	199.91	685.84	164,402.75
13	4	164,402.75	200.74	685.01	164,202.01
14	5	164,202.01	201.58	684.18	164,000.43
15	6	164,000.43	202.42	683.34	163,798.01
16	7	163,798.01	203.26	682.49	163,594.74
360	351	8,657.91	849.68	36.07	7,808.23
361	352	7,808.23	853.22	32.53	6,955.01
362	353	6,955.01	856.78	28.98	6,098.23
363	354	6,098.23	860.35	25.41	5,237.88
364	355	5,237.88	863.93	21.82	4,373.95
365	356	4,373.95	867.53	18.22	3,506.42
366	357	3,506.42	871.15	14.61	2,635.28
367	358	2,635.28	874.78	10.98	1,760.50
368	359	1,760.50	878.42	7.34	882.08
369	360	882.08	882.08	3.68	(0.00)

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Linking Worksheets with 3-D Cell References. (Creating a Summary Worksheet)

Follow-along file: Continue with Excel Objective 2.00. (Use file Excel Objective 2.12 if starting here.)

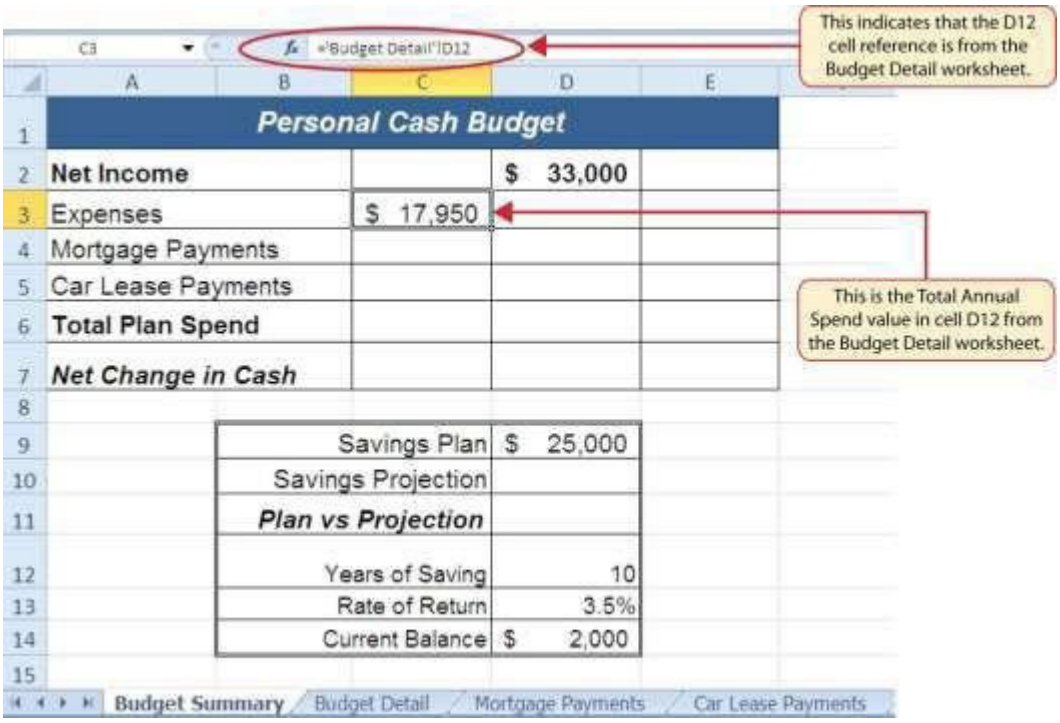
So far, we have used cell references and named cells in formulas and functions, which allows Excel to produce new outputs when the values in the cell references are changed. Cell references can also be used to display values or the outputs of formulas and functions in cell locations on other worksheets. This is how data will be displayed on the **Budget Summary** worksheet in the Personal Budget workbook. Outputs from the formulas and functions that were entered into the **Budget Detail**, **Mortgage Payments**, and **Car Lease Payments** worksheets will be displayed on the **Budget Summary** worksheet using 3-D cell references. The following steps explain how this is accomplished:

1. Click cell C3 in the **Budget Summary** worksheet.
2. Type an equal sign (**=**).
3. Click the **Budget Detail** worksheet tab.
4. Click cell D12 on the **Budget Detail** worksheet.
5. Press the ENTER key on your keyboard. The output of the SUM function in cell D12on the Budget Detail worksheet will be displayed in cell C3 on the Budget Summary worksheet.

Figure 2.36 "Cell Reference Showing the Total Expenses in the Budget Summary Worksheet" shows how the cell reference appears in the Budget Summary worksheet. Notice that the cell reference D12 is preceded by the **Budget Detail** worksheet name enclosed in apostrophes followed by an exclamation point ('Budget Detail'!) This indicates that the value displayed in the cell is referencing a cell location in the **Budget Detail** worksheet.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.36 Cell Reference Showing the Total Expenses in the Budget Summary Worksheet


This indicates that the D12 cell reference is from the Budget Detail worksheet.
This is the Total Annual Spend value in cell D12 from the Budget Detail worksheet.
Personal Cash Budget
Net Income $ 33,000
Expenses $ 17,950
Mortgage Payments
Car Lease Payments
Total Plan Spend
Net Change in Cash
Savings Plan $ 25,000
Savings Projection
Plan vs Projection
Years of Saving 10
Rate of Return 3.5%
Current Balance $ 2,000
Budget Summary
Budget Detail
Mortgage Payments
Car Lease Payments

As shown in Figure 2.36 "Cell Reference Showing the Total Expenses in the Budget Summary Worksheet", the **Budget Summary** worksheet is designed to show the expense budget for the mortgage payments and the auto lease payments. However, you will recall that we used the PMT function to calculate the monthly payments. In the **Budget Summary** worksheet, we need to show the total annual payments. As a result, we will create a formula that references cell locations in the **Mortgage Payments** and **Car Lease Payments** worksheets. The following steps explain how this is accomplished:

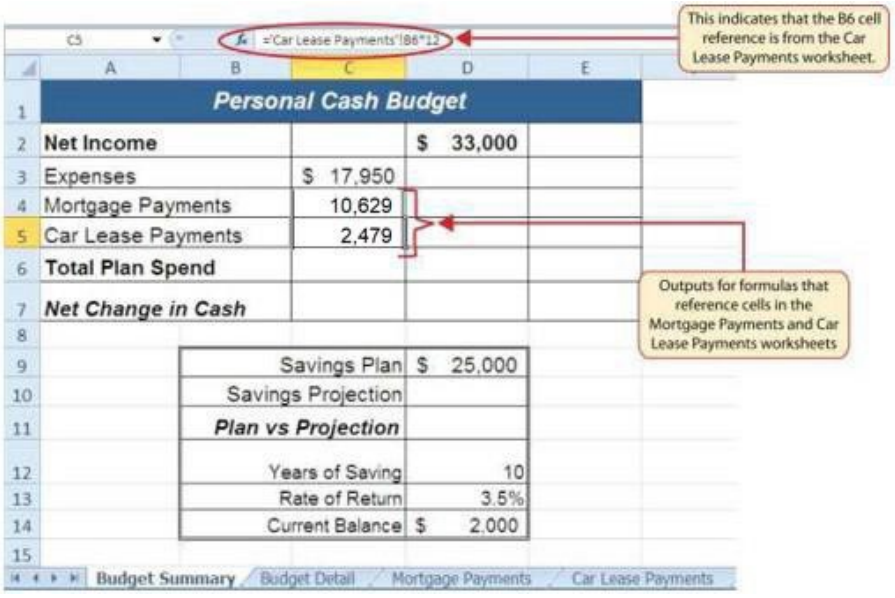
1. Click cell C4 in the **Budget Summary** worksheet.
2. Type an equal sign (**=**).
3. Click the **Mortgage Payments** worksheet tab.
4. Click cell B5 in the **Mortgage Payments** worksheet.
5. Type an asterisk (*) for multiplication.
6. Type the number **12**. This multiplies the monthly payments by 12 to calculate the total payments required for the year.
7. Press the ENTER key on your keyboard. The value of multiplying the monthly mortgage payments by 12 is now displayed on the **Budget Summary** worksheet.
8. Click cell C5 on the **Budget Summary** worksheet.
9. Type an equal sign (**=**).

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

10. Click the **Car Lease Payments** worksheet tab.
11. Click cell B6 in the **Car Lease Payments** worksheet.
12. Type an asterisk (*) for multiplication.
13. Type the number **12**. This multiplies the monthly lease payments by 12 to calculate the total payments required for the year.
14. Press the ENTER key on your keyboard. The value of multiplying the monthly lease payments by 12 is now displayed on the **Budget Summary** worksheet.
15. Highlight cells C4:C5, format Comma with no decimal places.

Figure 2.37 "Formulas Referencing Cells in Mortgage Payments and Car Lease Payments Worksheets" shows the results of creating formulas that reference cell locations in the **Mortgage Payments** and **Car Lease Payments** worksheets.

Figure 2.37 Formulas Referencing Cells in Mortgage Payments and Car Lease Payments Worksheets


This indicates that the B6 cell reference is from the Car Lease Payments worksheet.
Outputs for formulas that reference cells in the Mortgage Payments and Car Lease Payments worksheets
Personal Cash Budget
Net Income $ 33,000
Expenses $ 17,950
Mortgage Payments 10,629
Car Lease Payments 2,479
Total Plan Spend
Net Change in Cash
Savings Plan $ 25,000
Savings Projection
Plan vs Projection
Years of Saving 10
Rate of Return 3.5%
Current Balance $ 2,000
Budget Summary
Budget Detail
Mortgage Payments
Car Lease Payments

We can now add other formulas and functions to the **Budget Summary** worksheet that can calculate the difference between the total spend dollars vs. the total net income in cell D2.

The following steps explain how this is accomplished:

1. Click cell D6 in the Budget Summary worksheet.
2. Click on AutoSum at in the Editing section of the Home ribbon.
3. Highlight the range C3:C5
4. Click Enter.

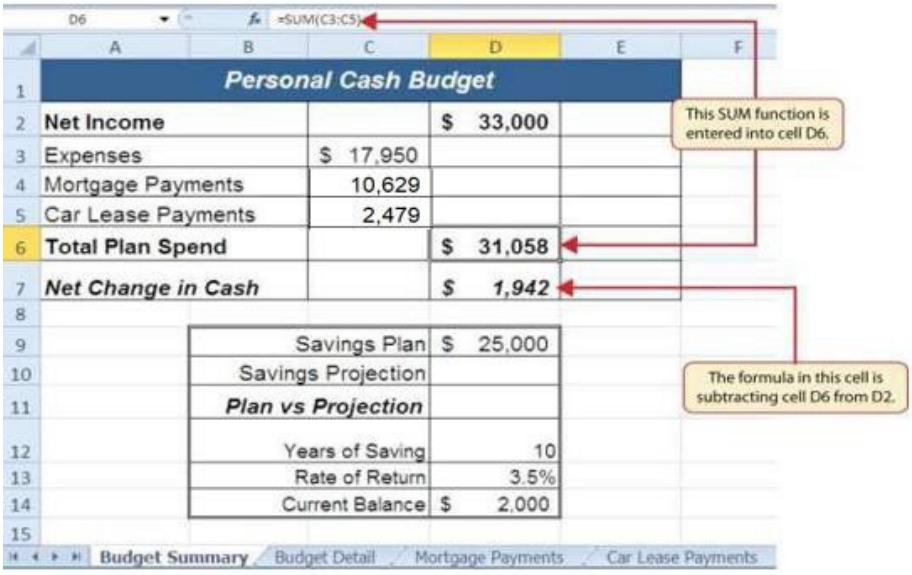
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

5. Click cell D7 on the Budget Summary worksheet.
6. Type an equal sign (=).
7. Click cell D2.
8. Type a minus sign (−) and then click cell D6.
9. Press the ENTER key on your keyboard. This formula produces an output of$1,942, indicating our income is greater than our total expenses.

Figure 2.38 "Formulas Added to Show Income Is Greater Than Expenses" shows the results of the formulas that were added to the **Budget Summary** worksheet. The output for the formula in cell D7 shows that the net income exceeds total planned expenses by $1,942.

Overall, having your income exceed your total expenses is a good thing because it allows you to save money for future spending needs or unexpected events.

Figure 2.38 Formulas Added to Show Income Is Greater Than Expenses



We can now add a few formulas that calculate both the spending rate and the savings rate as a percentage of net income. These formulas require the use of absolute references, which we covered earlier in this chapter. The following steps explain how to add these formulas:

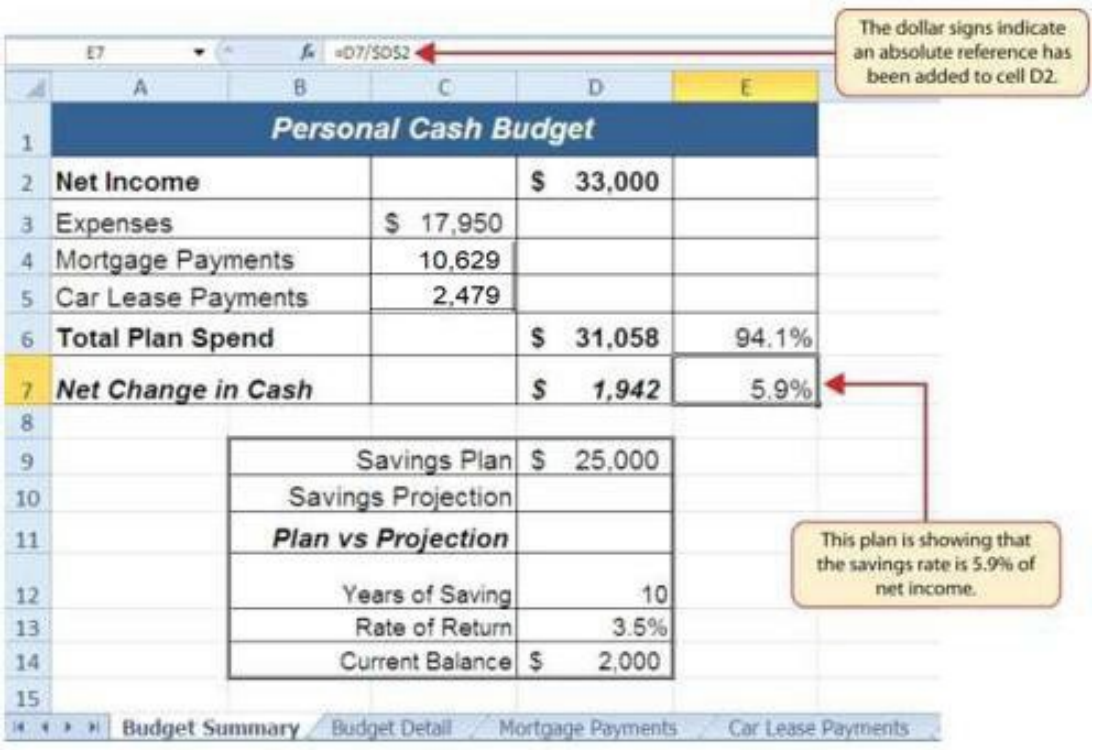
1. Click cell E6 in the **Budget Summary** worksheet.
2. Type an equal sign (**=**).
3. Click cell D6.
4. Type a forward slash (**/**) for division and then clickD2.
5. Press the F4 key on your keyboard. This adds an absolute reference to cell D2.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

6. Press the ENTER key. The result of the formula shows that total expenses consume 94.1% of our net income.
7. Click cell E6.
8. Place the mouse pointer over the Auto Fill Handle.
9. When the mouse pointer turns to a black plus sign, left click and drag down to cell E7. This copies and pastes the formula into cell E7.

Figure 2.39 "Calculating the Savings Rate" shows the output of the formulas calculating the spending rate and savings rate as a percentage of net income. The absolute reference shown for cell D2 prevents the cell from changing when the formula is copied from cell E6 and pasted into cell E7. The results of the formula show that our current budget allows for a savings rate of 5.9%. This is a good savings rate. In the next section, we will discuss how these savings can grow over time by exploring the time value of money concepts.

Figure 2.39 Calculating the Savings Rate


E7
=D7/$D$2
The dollar signs indicate an absolute reference has been added to cell D2.
Personal Cash Budget
Net Income $ 33,000
Expenses $ 17,950
Mortgage Payments 10,629
Car Lease Payments 2,479
Total Plan Spend $ 31,058 94.1%
Net Change in Cash $ 1,942 5.9%
Savings Plan $ 25,000
Savings Projection
Plan vs Projection
Years of Saving 10
Rate of Return 3.5%
Current Balance $ 2,000
This plan is showing that the savings rate is 5.9% of net income.
Budget Summary
Budget Detail
Mortgage Payments
Car Lease Payments

Time Value of Money Concepts

Follow-along file: Continue with Excel Objective 2.00. (Use file Excel Objective 2.13 if starting here.)

In reviewing the **Budget Summary** worksheet in Figure 2.39 "Calculating the Savings Rate", you will notice that the range B9:D14 contains data that can be used to assess a savings plan. We can project how much money can be saved over a specific period of time

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

given set contributions and a rate of return. This calculation is accomplished through the future value, or FV, function. We will use the FV function in cell D10 of the **Budget Summary** worksheet to calculate our savings plan projection. However, before we use the FV function, it is important to review a few basic concepts regarding the time value of money, as shown in Table 2.7 "Key Terms for Time Value of Money Concepts".

Table 2.7 Key Terms for Time Value of Money Concepts

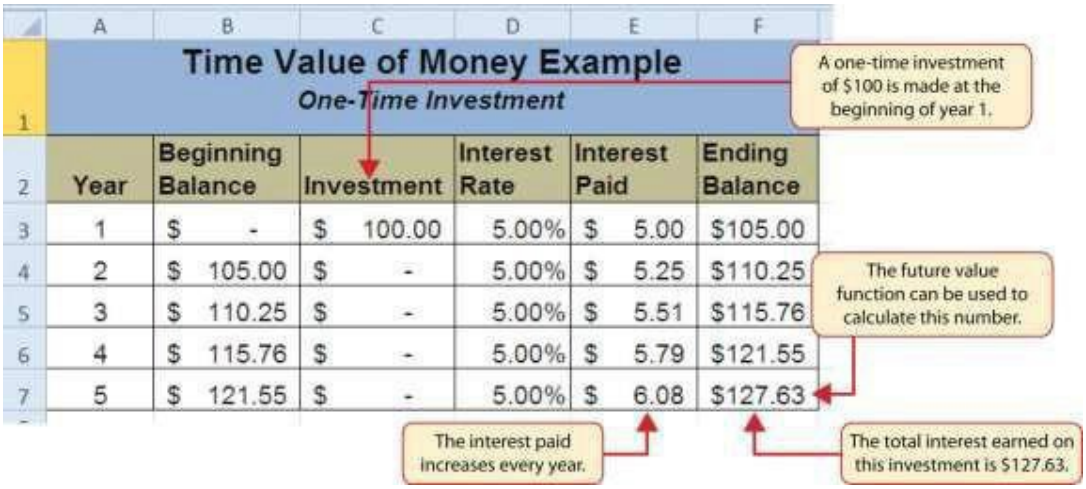
Argument	Definition
Annuity	An investment that is made in regular payments over a period of time. For example, depositing $100 a month into an interest-bearing bank account or mutual fund is considered an annuity.
Bonds	An investment in which you lend money to a company or government entity. The borrower agrees to pay you interest over a specific period time. At the end of the bond agreement, the amount of money that was borrowed, or your initial investment, is returned to you. Most bonds are considered a lower risk investment but offer a lower rate of return than stocks offer.
Mutual Funds	A collection of similar investments managed by a financial professional called a fund manager. Mutual funds allow you to invest in several stocks or bonds without having to make many individual investments. They also allow you to reduce your risk and take advantage of the investment expertise of a professional.
Rate of Return	The percentage gained or lost on an investment. Investments that offer a high predicted rate of return often carry a higher risk of losing money. Investments that offer a lower predicted rate of return often carry a lower risk of losing money.
Stocks	An investment in which you own a portion of a company. The value of this investment increases as the company produces higher profits. Most stocks are expected to generate a higher rate of return than bonds generate. However, the risk of losing money on a stock investment is much greater than the risk for bonds.

Table 2.7 "Key Terms for Time Value of Money Concepts" provides definitions for several terms used when addressing the *time value of money* concepts. The time value of money is the opportunity to grow your money over time given a constant or average rate of return. For example, consider the data shown in Figure 2.40 "Time Value of Money Example for a One-Time Investment". This data assumes that a person makes a one-time investment of $100 in a bond mutual fund that returns 5% interest per year. Notice that the interest paid in Column E increases every year. This is because the interest is reinvested in the

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

mutual fund, which increases the total value of the investment. For example, the interest earned in year 1 is based on a $100 investment. Therefore, the interest paid is $5.00, or 5% of $100. However, in year 2, when the $5.00 interest payment is reinvested, the total investment increases to $105. Therefore, in year 2 the interest paid increases to $5.25, or 5% of $105. The value of the investment at the end of 5 years is $127.63. This is the value that can be calculated using the FV function.

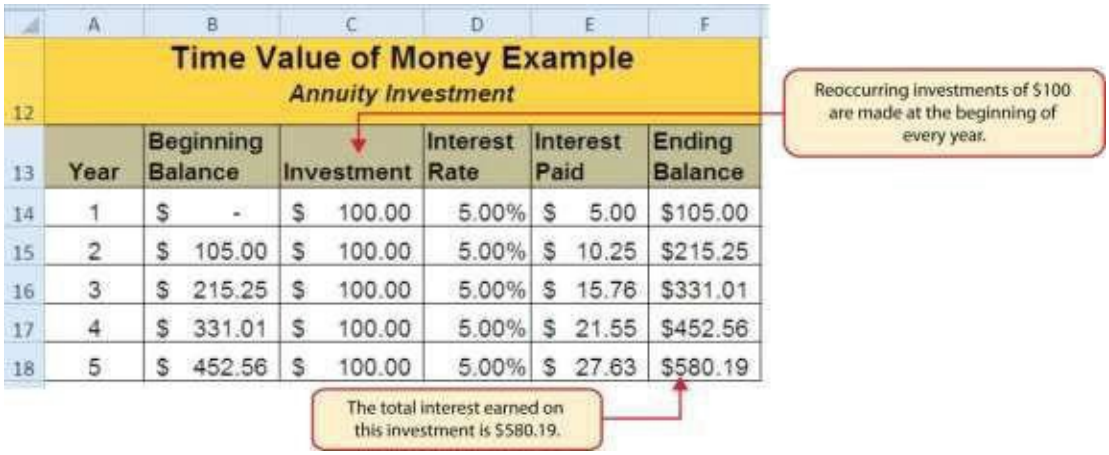
Figure 2.40 Time Value of Money Example for a One-Time Investment


Time Value of Money Example
One-Time Investment
A one-time investment of $100 is made at the beginning of year 1.
The future value function can be used to calculate this number.
The interest paid increases every year.
The total interest earned on this investment is $127.63.

Year	Beginning Balance	Investment	Interest Rate	Interest Paid	Ending Balance
1	$ -	$ 100.00	5.00%	$ 5.00	$105.00
2	$ 105.00	$ -	5.00%	$ 5.25	$110.25
3	$ 110.25	$ -	5.00%	$ 5.51	$115.76
4	$ 115.76	$ -	5.00%	$ 5.79	$121.55
5	$ 121.55	$ -	5.00%	$ 6.08	$127.63

Figure 2.41 "Time Value of Money Example for an Annuity Investment" shows another example demonstrating the time value of money concept. Instead of making a one-time investment, we will assume that a person invests $100 at the beginning of every year in the same bond mutual fund. This is referred to as an annuity because the person is making reoccurring investments over a specific period of time. Notice that the value of this investment after 5 years is $580.19. Also, the total interest earned on this investment is $80.19 as opposed to the $27.63 earned on the one-time investment in Figure 2.40 "Time Value of Money Example for a One-Time Investment".

Figure 2.41 Time Value of Money Example for an Annuity Investment


Time Value of Money Example
Annuity Investment
Reoccurring investments of $100 are made at the beginning of every year.
The total interest earned on this investment is $580.19.

Year	Beginning Balance	Investment	Interest Rate	Interest Paid	Ending Balance
1	$ -	$ 100.00	5.00%	$ 5.00	$105.00
2	$ 105.00	$ 100.00	5.00%	$ 10.25	$215.25
3	$ 215.25	$ 100.00	5.00%	$ 15.76	$331.01
4	$ 331.01	$ 100.00	5.00%	$ 21.55	$452.56
5	$ 452.56	$ 100.00	5.00%	$ 27.63	$580.19

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

The FV (Future Value) Function

Follow-along file: Continue with Excel Objective 2.00. (Use file Excel Objective 2.13 if starting here.)

Establishing a personal savings plan is one of the most important financial exercises you can do. For example, a savings plan is critical for establishing financial security for your retirement years. Many people mistakenly believe that saving for retirement is something you do when you get older. However, the greatest financial gains for your retirement can be achieved if you start saving in the earliest years of your career.

Now that you understand the time value of money, you can see that the more years you can earn interest on your investments and reinvest those earnings, the more money you will have when you retire. Savings plans are also important for other key life events, such as going to college or buying a home.

FV = (RATE, NPER, PMT,[PV],[TYPE])

The FV function is a convenient tool that can help you establish savings goals and project the value of your investments over time. Like the PMT function, the FV function requires you to accurately define specific arguments in order to produce a reliable result. Table 2.8 "Arguments for the FV Function" provides definitions for each of the arguments in the FV function. It is helpful to review the time value of money terms in Table 2.7 "Key Terms for Time Value of Money Concepts" before using the FV function.

Table 2.8 Arguments for the FV Function

Argument	Definition
Rate	This is the rate of return you expect to earn on an investment over time. This rate is usually quoted in annual terms, so you must divide by the number of payments made per year.
Nper	The argument letters stand for *number of periods*. This is the amount of time you are using to measure the value of an investment. The amount of time used to define this argument must be comparable to the Rate argument. Forexample, if the rate is stated in terms of months, the amount of time used to define this argument must be in months.
Pmt	The argument letters stand for *payment*. This argument is used if you are measuring the value of an annuity investment. The argument is defined withthe value of the investment that is made for each measure of time used to define the Nper argument. For example, if the Nper argument is expressed in terms of months, you must define this argument with the investment value that is made every month.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

[Pv]	The argument letters stand for *present value*. The brackets around the argument indicate that it is not always necessary to define it. Excel assumes zero if the argument is not defined. The argument is used when measuring the value of a one-time investment. Both this argument and the Pmt argument will be defined if an annuity investment has a beginning balance or includes a beginning one-time lump-sum investment.
[Type]	This argument can be defined with either a 1 or a 0. The number 1 is used if investments are made at the beginning of each period used to define the Nper argument. A 0 is used if the investments are made at the end of each period. The argument is in brackets because it does not have to be defined if your investments are made at the end of each period. Excel assumes that this argument is 0 if it is not defined.

With respect to the Personal Budget workbook, we will use the FV function to project the value of the savings plan in 10 years. We will type the function directly into the **Personal Budget** worksheet for this demonstration. However, you can use any of the methods demonstrated in this chapter for future use.

The following steps explain how this function is added to the worksheet:

1. Click cell D10 in the **Budget Summary** worksheet.
2. Type an equal sign (**=**).
3. Type the letters **FV** followed by an open parenthesis(**(**).
4. Click cell D13. This is the expected rate of return for the investments.
5. Type a comma.
6. Click cell D12. This is the amount of time the investments are expected to grow.
7. Type a comma.
8. Type a minus sign (**–**). All values or cell locations used to define the Pmt argument must be preceded by a minus sign.
9. Click cell D7. This is the change in cash that was calculated by subtracting the total expenses from the net income. We are expecting to save this amount of money for the 10-year period this investment is being measured.
10. Type a comma.
11. Type a minus sign (**–**). All values and cell locations used to define the Pv argument must be preceded by a minus sign.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

12. Click cell D14. Since the savings plan has a current balance, we use this to define the Pv argument of the function. This is equivalent to starting with a lump-sum investment.
13. Type a closing parenthesis **)**. There is no need to define the last argument of the function because we will assume that the savings in cash achieved in our budget will be invested at the end of each year of the savings plan. Press the ENTER key

Now we will check to see if our savings plan is over, or short of, its goal.

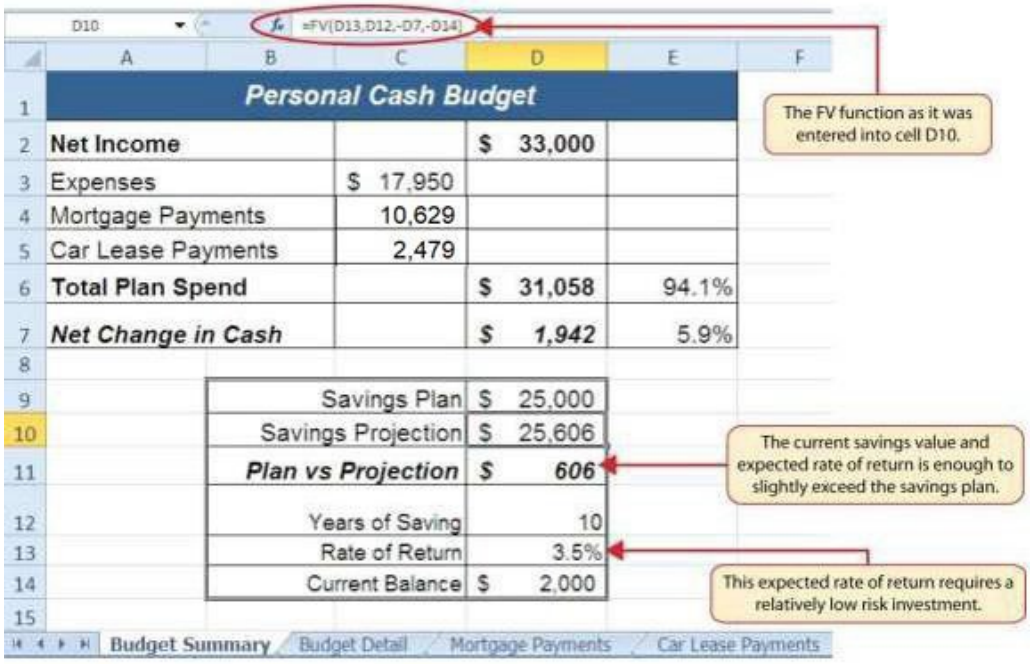
14. . Check that cell D11 isactivated.
15. Type an equal sign (**=**).
16. Click cell D10.
17. Type a minus sign (**–**) and then click cell D9. This subtracts the savings plan from the current savings plan projection.
18. Press the ENTER key.

Integrity Check - PMT and FV Functions Produce Negative Results
If the results of the PMT function or FV function are negative, check the Pv or Pmt arguments. Remember that these arguments must be preceded by a minus sign. If the minus sign is omitted, the functions produce a negative output.

Figure 2.42 "Results of the Savings Plan Projections" shows the results of the FV function. Notice that the current savings plan projection is $25,606. This is $606 higher than the target of $25,000 entered into cell D9, which shows that the current budget is working to achieve the goals of this savings plan. In other words, given the current net income, we are saving enough money to achieve our savings plan goals.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.42 Results of the Savings Plan Projections


D10
=FV(D13,D12,-D7,-D14)
Personal Cash Budget
Net Income $ 33,000
Expenses $ 17,950
Mortgage Payments 10,629
Car Lease Payments 2,479
Total Plan Spend $ 31,058 94.1%
Net Change in Cash $ 1,942 5.9%
Savings Plan $ 25,000
Savings Projection $ 25,606
Plan vs Projection $ 606
Years of Saving 10
Rate of Return 3.5%
Current Balance $ 2,000
The FV function as it was entered into cell D10.
The current savings value and expected rate of return is enough to slightly exceed the savings plan.
This expected rate of return requires a relatively low risk investment.
Budget Summary
Budget Detail
Mortgage Payments
Car Lease Payments

There are two important factors to note about this plan. The first factor is that our spending plan allows us to save enough money so that it can be invested to achieve our target of $25,000. The second factor is that the expected rate of return is 3.5%. This is a relatively low expected rate of return and could be achieved by investing in relatively low-risk investments such as bonds as opposed to stocks. This rate can be considered good because we can achieve our savings goals without having to make high-risk investments that could result in a significant loss of our savings. If the results of the PMT function or FV function are negative, check the Pv or Pmt arguments. Remember that these arguments must be preceded by a minus sign. If the minus sign is omitted, the functions produce a negative output.

NPER

Follow-along file: Continue with Excel Objective 2.00. (Use file Excel Objective 2.14 if starting here.)

Given the home loan example above there are other financial functions that can be used to help make financial decisions when borrowing money. For instance, if we can afford to pay $1,000 per month for our loan and the bank will loan to us at 5% interest on a $165,000 loan, how long will it take to pay off that loan?

The NPER function solves for the total number of payments it will take to pay off this loan. The function is:

=NPER (RATE,PMT,-PV,[FV],[Type])

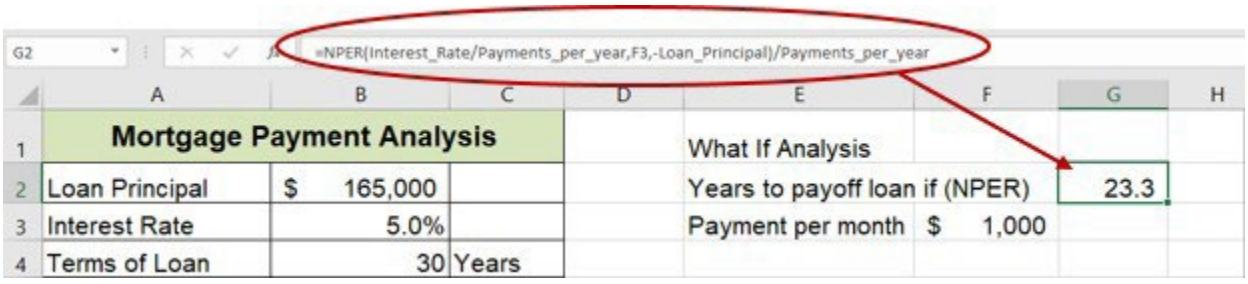
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Return to the Mortgage Payments worksheet and complete the following steps:

1. In cell E1 type: What if Analysis
2. In cell E2 type: Years to payoff loan if: (NPER)
3. In cell E4 type: Payment per month:
4. In cell E5 enter $1,000
5. In G2 enter =NPER (
6. Click on cell B3 – the interest rate in the mortgage analysis section. Enter the divisor (/) and click on the Payments per year in cell B5 to calculate the periodic interest rate. Type a comma.
7. Click on the $1,000 in cell F3 for the PMT argument and then enter a comma.
8. Enter a minus sign (-) and click on B2, the Loan Principal and then hit Enter. The result shows 279.74 payments.
9. To solve for the number of years we must divide the total number of payments by the payments per year. Click in the formula bar for G3. After the closing parenthesis divide **(/)** the result by the payments per year in cell B5.
10. Format cell G3 for comma with one decimal place.

Figure 2.43 shows the result that being able to pay an extra $115 per month on a 30 year loan will cut 7 years off the length of this loan.

Figure 2.43 Years to Payoff Loan at $1,000 per Month



RATE

Follow-along file: Continue with Excel Objective 2.00. (Use file Excel Objective 2.15 if starting here.)

Another what if analysis you can play with when making financial decisions around loans is what is the highest interest rate you can afford to pay given your financial situation.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Let's assume that the most we can afford to pay monthly for the loan is $800. Everything else will remain the same in our Mortgage analysis, but we will know before entering into a loan how much interest we can afford. We will do this by solving for the RATE.

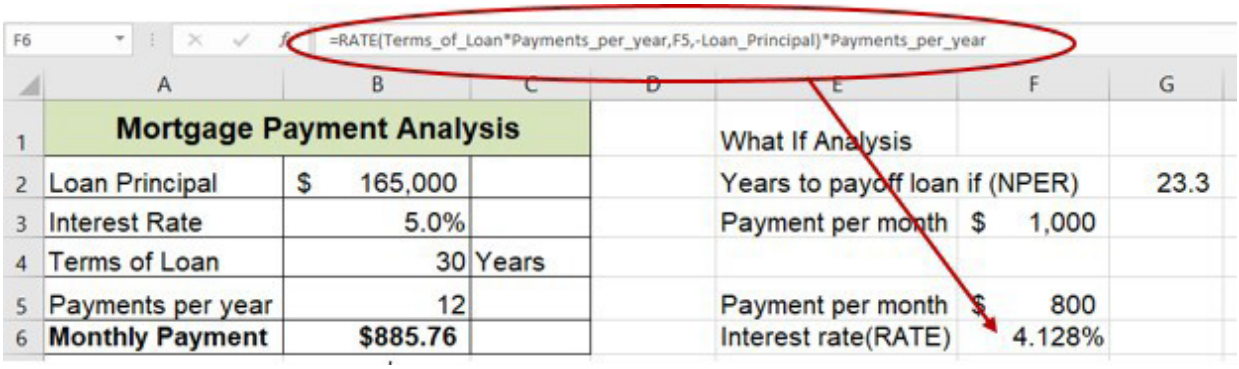
The RATE function solves for the periodic interest rate. The arguments in the function are:

=RATE (NPER,PMT, -PV,[FV],[Type])

1. On the Mortgage Payments worksheet, in cell E5 type: Payment per month.
2. In F5, type: $800
3. In cell E6, type Interest rate (RATE)
4. In cell F6 enter =RATE (
5. Calculate the NPER by clicking on cell B4 and multiply (*) by B5. Enter a comma.
6. Enter the payment amount by clicking on cell F5 and enter a comma.
7. Enter a minus sign (-) and click on the loan principal in cell B2.
8. Finish the function by typing the closing parenthesis.
9. The result in cell F6 may show 0%. Increase decimal places to show 3 decimal places. The periodic interest rate is 0.344%. To calculate the annual interest rate, you must multiply the result of the RATE function by the number of payments peryear.
10. Make cell F6 active and click in the formula bar. At the end of your RATE function multiply the function by payments per year in B5.

Figure 2.44 shows the results of the RATE function. You would have to get an interest rate of 4.125% to be able to afford the $165,000 house at $800 per month.

Figure 2.44 Interest Rate Required to Pay off Loan at $800 per Month



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Key Takeaways

- The PMT function can be used to calculate the periodic mortgage payments for a house or the monthly lease payments for a car.
- When using the PMT or FV functions, each argument must be separated by a comma.
- When using the PMT or FV functions, the arguments must be defined in comparable terms. For example, when using the FV function, if the Pmt argument is defined using monthly payments, the Rate and Nper arguments must be defined in terms of months.
- The FV function is used to calculate the value of an investment at a future point in time given a constant rate of return.
- The PMT and FV functions produce a negative output if the Pmt or Pv arguments are not preceded by a minus sign.
- The RATE function can be used to find your periodic interest rate.
- The NPER function can be used to determine total number of payments in a loan.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

EXERCISES

1. Which statement best explains the setup of the following payment function =PMT (.06,30,–200000,50000,0)? Note that the 6% annual interest rate is expressed in decimal terms as .06.
   a. The function is calculating the monthly payments of a $200,000 loan, 6% interest rate, over 30 years, with a lump-sum payment of $50,000 at the end of the loan. Payments are due at the end of every month.
   b. The function is calculating the annual payments of a $200,000 loan, 6%interest rate, over 30 years, with a lump-sum payment of $50,000 at the end of the loan. Payments are due at the end of every year.
   c. The function is calculating the monthly payments of a $200,000 loan, 6% interest rate, over 30 years, with a lump-sum payment of $50,000 at the end of the loan. Payments are due at the beginning of every month.
   d. The function is calculating the annual payments of a $200,000 loan, 6% interest rate, over 30 years, with a lump-sum payment of $50,000 at the end of the loan. Payments are due at the beginning of every year.

2. When leasing a car, the residual value will be used to define which of the following?
   a. the Pv argument in the FV function
   b. the Pv argument in the PMT function
   c. the Pmt argument in the FV function
   d. the Fv argument in the PMT function

3. The recurring investments in an annuity investment would be used to define which of the following?
   a. the Pmt argument in the FV function
   b. the Pv argument in the FV function
   c. the Fv argument in the PMT function
   d. the Pv argument in the PMT function

4. Which of the following PMT functions will accurately calculate the monthly payments on a mortgage if the price of the house is $300,000, a down payment of $60,000 is made, the interest rate is 5%, the term of the loan is 30 years, and payments are due at the end of every month?

   a.=PMT (.05/12,30*12,–300000,60,000,0)
   b.=PMT(.05,30*12,–300000,60000,0)
   c.=PMT(.05/12,30*12,–240000)
   d.=PMT(.05/12,30,–240000,0)

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Chapter Assignments and Tests

To assess your understanding of the material covered in the chapter, please complete the following assignments.

Careers in Practice (Chapter 2.1 and 2.2 Skills Review 1)

Family Budgeting

Starter File: Chapter 2 CiP Exercise 1.1

Difficulty: Level 1 Easy

The Smith family is establishing their annual budget for 2026. They want to be able to track their spending and compare it to what they project they should be spending. Begin this exercise by opening the Chapter 2 CiP Exercise 1.1 file.

1. In the range C15:N15, use AutoFill (pages 30-33) to replace the month numbers with the abbreviations Jan through Dec.
2. In cell C18 use AutoSum to calculate the couple's monthly total income. Use the Auto Fill to copy the Jan income across cells D18:N18.
3. In cell C24 use AutoSum to calculate the couple's monthly total expenses. (*Caution: Verify Excel is choosing the correct range of cells C19:C23.)* Use the Auto Fill to copy the Jan expenses across cells D24:N24.
4. In cell C25 calculate the net cash flow by subtracting C24 from C18. Use autofill to copy the formula across to N25.
5. In cell C27 link to the net cash flow balance in cell C25 by type = and clicking on cell C25 then add savings balance in cell B27. Then hit enter. =C25 + B27. Copy across through N27.
6. In cell C4 use the SUM function to calculate the total of John's salary for the year.
7. In cell D4 use the AVEAGE function to calculate the average of John's salary for the year.
8. In cell E4 use the MAX function to calculate the maximum salary John earned during the year.
9. In cell F4 use the MIN function to calculate the minimum salary John earned during the year.
10. Complete the Year-End Summary by selecting the range C4:F4 and AutoFill the functions down through row 13. (*Note: ignore the #DIV/0! Error in cell D11. It has occurred because our mortgage expense row C23:N23 is empty. It will correct when we enter the mortgage data.)*

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

11. In the range C30:C35 enter the following loan conditions*: (Note: we will deal with financial functions in the next section.)*

a. In cell C30 enter 4.5% for the annual interest rate.

b. In cell C31 enter 12 for the number of payments per year.

c. In cell C32 enter 20 for the years in the loan.

d. In cell C33 enter $300,000 as the loan amount for the principal.

12. In cell C23, link to cell C34 by entering an = and clicking on cell C34. Click the F4 function key to make C34 an absolute cell reference $C$34.

13. Copy cell C23 across D23:N23.

Now that the worksheet calculations are correct, we will format the worksheet to make it easy to read and add a title.

14. Highlight the range C4:F4 and format for $ with 0 decimal places. Repeat for the ranges, C12:F13, C16:N16, C25:N25, and B27:N27.

15. Highlight the range C5:F11 and format for comma with zero decimal places. Repeat for the ranges C17:N24

16. To separate out the totals for income and expenses to make them easier to read we will add a top and bottom border by highlighting the range C6:F6 and apply the Top and Bottom border style. Repeat for the ranges C12:F12, C18:N18, C24:N24.

17. Bold the cells B6, B12, B18, and B24.

18. Within the title in A1, add a second row to the title that reads Projected for 2024. Merge and center the title across the cells A1:N1. Resize the title row so both rows show.

19. Analysis question. John and Mary want to maintain an average net cash flow of at least $1,000 per month. Are they achieving this? Why or why not?

20. Save the workbook by adding your name in front of the current workbook name (i.e., "your name Chapter 2 CiP Exercise 1.1").

Careers in Practice (Skills Review 2)

Financial Plan for a Lawn Care Business (Comprehensive Review) Starter File: Chapter 2 CiP Exercise 1.2

Difficulty: Level 1 Easy

Running your own lawn care business can be an excellent way to make money over the summer while on break from college. It can also be a way to supplement your existing income for the purpose of saving money for retirement or for a college fund. However, managing the costs of the business will be critical for it to be a profitable venture. In

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

this exercise, you will create a simple financial plan for a lawn care business by using the skills covered in this chapter. Begin this exercise by opening the file named Chapter 2 CiP Exercise 1.2.

1. Click cell C5 in the **Annual Plan** worksheet.
2. Enter a formula that calculates the average price per lawn cut. Type an equal sign (**=**), then click cell B3. Type the asterisk symbol (***)** for multiplication, then click cell B4. Press the ENTER key.
3. Click cell C8 in the **Annual Plan** worksheet.
4. Enter a formula that calculates the total number of lawns that will be cut during the year. Type an equal sign (**=**), then click cell B6. Type the asterisk symbol (*) for multiplication, then click cell B7. Press the ENTER key.
5. Click cell D9 in the **Annual Plan** worksheet.
6. Enter a formula that calculates the total sales for the plan. Type an equal sign (**=**), then click cell C5. Type the asterisk symbol (*) for multiplication, then click cell C8. Press the ENTER key.
7. Click cell F3 in the Leases worksheet. The PMT function will be used to calculate the monthly lease payment for the first item. For many businesses, leasing (or renting) equipment is a more favorable option than purchasing equipment because it requires far less cash. This enables you to begin a business such as a lawn care business without having to put up a lot of money to buy equipment. Type an equal sign (=) followed by the function name PMT and an open parenthesis (). Define the arguments of the function as follows:
    a. *Rate:* Click on cell B3, Interest_Rate, type a forward slash (/) for division, type the number **12**, and type a comma. Since we are calculating monthly payments, the annual interest rate must be converted to a monthly interest rate.
    b. *Nper:* Click on cell C3, Terms_of_Lease_in_Years, type an asterisk (*) for multiplication, type the number 12, and type a comma. Like the Rate argument, the terms of the lease must be converted to months since we are calculating monthly payments.
    c. *Pv:* Type a minus sign (**–**), Click on cell D3, Price, and type a comma. Remember that this argument must always be preceded by a minus sign.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

d. *Fv:* Click on cell E3, select Residual_Value, and type a comma. *Type:* Type the number 1, type a closing parenthesis ()), and press the ENTER key. We will assume the lease payments will be made at the beginning of each month, which requires that this argument be defined with a value of1.

Integrity Check - Using a named range in a function
When using a named range in a function you must select the named range from the Use in Formula dropdown or start typing the named range and double click on it when it appears in the function dropdown list from inside the formula. When copying the formula down the page, Excel will automatically change the cell references from within the named ranges to match the current data from the row being calculate.

9. Copy the PMT function in cell F3 and paste it into the range F4:F6.
10. Click cell F10 in the Leases worksheet. A SUM function will be added to calculate the total for the monthly lease payments.
11. Click on F10 and use the AutoSum to total the column. You will notice that blank rows were included in this range for the SUM function. If other items are added to the worksheet, they will be included in the output of the SUM function.
12. Highlight the range A2:F6 on the Leases worksheet. The data in this range will be sorted.
13. Click the Sort button in the Data tab of the Ribbon. In the Sort dialog box, select the Interest Rate option in the "Sort by" drop-down box. Select Largest to Smallest for the sort order. Then, click the Add Level button on the Sort dialog box. Select the Price option in the "Then by" drop-down box. Select Largest to Smallest for the sort order. Click the OK button in the Sort dialog box.
14. Reformat columns D:F so $ are only in the top and Total rows. Format column F for two decimal places.
15. Click cell B11 on the Annual Plan worksheet. The monthly lease payments that are calculated in the Lease worksheet will be displayed in this cell.
16. Type an equal sign (=). Click the Leases worksheet tab, click cell F10, and press the ENTER key.
17. Click cell C12 on the Annual Plan worksheet.
18. Type an equal sign (=) and click cell B11. Type an asterisk (*), type the number 12,and press the ENTER key. This formula calculates the annual lease payments.
19. Format the output of the formula in cell C12 so the decimal places are reduced to zero.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

20. Click cell C14 on the Annual Plan worksheet.
21. Type an equal sign (=) and click cell B13. Type an asterisk (*), click cell C8, and press the ENTER key.
22. Click cell D16 on the Annual Plan worksheet.
23. Type an equal sign (=) followed by the word SUM and an open parenthesis (). Highlight the range C11:C15, type a closing parenthesis (), and press the ENTER key. This SUM function adds the total expenses for the business.
24. Click cell D17 on the Annual Plan worksheet.
25. Type an equal sign (=). Click cell D9, type a minus sign (–), click cell D16, and press the ENTER key. This formula calculates the annual profit for the business.
26. Name the cell D17 Operating_Income by typing it in the Cell address block and pressing enter.
27. Click cell A12 on the Investments worksheet.
28. In cell A12 type Investment Period. In B12 type 10. We will be projecting investment growth over the next 10 years.
29. Name B12 Investment_Period.
30. In cell B10, type an equal sign (=) followed by the word COUNT and an open parenthesis (). Highlight the range B3:B8, type a closing parenthesis (), and press the ENTER key. This function counts the number of investments that currently have a balance. Notice that additional blank rows were included in the range for this function. The function output will automatically change if any new investments are added to the worksheet.
31. Name cell B10 Number_of_Investments by typing it in the Cell address block and pressing Enter.
32. Click cell D3 on the Investments worksheet.
33. Type an equal sign (=). From the Use in Formulas select Operating_Income. Type a forward slash (/) for division. Click cell B10 and press the ENTER key. This formula divides the profit calculated on the Annual Plan worksheet by the number of investments in the Investments worksheet. We will assume that the profits from this business will be invested evenly among the funds listed in Column A of the Investments worksheet.
34. Copy cell D3 and paste it into cells D4 and D5.
35. Click cell E3 on the Investments worksheet. The future value function will be added to project the total growth of the investments listed in Column A. We will assume that the

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

business will be able to consistently generate profit, which will be invested evenly in the funds every year.

36. Type an equal sign (=) followed by the function name FV and an open parenthesis(). Define the arguments of the function as follows:
    a. *Rate:* Click on cell C3, Target_Growth_Rate ,and type a comma. This is the expected growth rate of the fund.
    b. *Nper:* From the Use in formula select Investment Period and type a comma. We are projecting the growth of these investments in 10years.
    c. *Pmt:* Type a minus sign (**–**), click on cell D3, Annual_Investments, and type a comma. Remember that this argument must always be preceded by a minus sign. We are assuming that the business will consistently generate the profits calculated in the **Annual Plan** worksheet and that these profits will be invested evenly into each fund.
    d. Pv: Type a minus sign (–) and click on the current balance in B3. Since each fund currently has a balance, we need to add this to the Pv argument of the function. Like the Pmt argument, remember that this argument must also be preceded by a minus sign.
    e. *Type:* Type a closing parenthesis (**)**) and press the ENTER key. We will assume the investments will be made at the end of each year. Therefore, it is not necessary to define this argument since Excel will assume zero, or end of the period, if it is not defined.
37. Copy the FV function in cell E3 and paste it into cells E4 and E5.
38. Create a total in cell E9.
39. Format cells D4:E8 for comma.
40. Add the current year to the title in each of the worksheets.
41. Save the workbook by adding your name in front of the current workbook name (i.e., "your name Chapter 2 CiP Exercise 1").
42. Close the workbook and Excel.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.49Completed CiP Exercise 1 Annual Plan Worksheet

	A	B	C	D
1	**Lawn Care Annual Financial Plan**			
2	**Sales Plan:**			
3	Price per Acre	$ 50.00		
4	Average Acreage per Customer	0.50		
5	Average Price per Cut		$ 25.00	
6	Number of Customers	30		
7	Frequency of Lawn Cuts per Customer	22		
8	Total Lawn Cuts		660	
9	***Total Sales***			***$ 16,500***
10	**Expenses:**			
11	Monthly Lease Payments	$122		
12	Annual Lease Payments		$1,461	
13	Lawn & Equipment Expenses Per Cut	$ 5.00		
14	Total Lawn & Equipment Expenses		$ 3,300	
15	Office and Other Expenses		$ 1,500	
16	***Total Expenses***			***$ 6,261***
17	**Operating Income**			**$ 10,239**

Figure 2.50Completed CiP Exercise 1 Investments Worksheet

	A	B	C	D	E
1	**Investment Analysis**				
2	**Investment Fund**	**Current Balance**	**Target Growth Rate**	**Annual Investments**	**10 Year Future Value**
3	Treasury Bond	$ 10,000	4.5%	$ 3,413	$ 57,470
4	Domestic Stock Fund	20,000	8.0%	3,413	92,622
5	Emerging Markets	10,000	10.5%	3,413	82,857
6					
7					
8					
9	**Total**				**$ 232,949**
10	**Number of Investments**	**3**			
11					
12	Investment Period	10			

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.51Completed CiP Exercise 1 Leases Worksheet

	A	B	C	D	E	F
1	**Equipment Leasing Plan**					
2	**Item**	**Interest Rate**	**Terms of Lease in Years**	**Price**	**Residual Value**	**Monthly Payment**
3	Blower	6.0%	3	$ 700	$ 200	$ 16.13
4	Commercial Lawn Mower	5.5%	4	6,000	3,000	$ 83.14
5	Edger	4.0%	2	400	150	11.32
6	Trimmer	4.0%	2	350	100	11.15
7						
8						
9						
10	**Total**					**$121.74**

Case Study 2.1 & 2.2: Hotel Management Cost Analysis

Starter File: Chapter 2 CiP Exercise 2

Difficulty: Level 2 Moderate

The hotel management industry presents a wide variety of career opportunities. These range from running your own bed and breakfast to a management position at a large hotel corporation. No matter what hotel management career you choose to pursue, understanding the costs for any hotel operation is critical to running a successful operation. This exercise examines the relationship between cleaning expenses and the occupancy rate of a small hotel. Cleaning expenses are obviously influenced by the occupancy rate of the hotel. As more rooms need to be cleaned, the amount of overall cleaning expenses increases. However, to accurately estimate these expenses, you need to know whether there is a baseline, or fixed portion, of these expenses that does not change no matter how many rooms need to be cleaned. In other words, if you pay a cleaning staff a fixed salary, it does not matter if they clean 1 room or 100 rooms; their salary will remain the same. However, you may need more cleaning supplies as the number of rooms that need to be cleaned increases. In addition, the replacement of guest necessities such as soap, shampoo, lotions, and so on will also increase as the number of rooms to be cleaned increases. This exercise will demonstrate how these costs can be estimated through a technique called the *high-low method*.

Begin this exercise by opening the file named *Chapter 2 CiP Exercise 2*.

1. On the Occupancy worksheet, select the range A5:F16. From the Data Ribbon, click on Sort. You will do a multi-level sort by Actual Occupancy, high to low, then by Cleaning Expense, high to low.
2. Enter a formula in cell C5 on the **Occupancy** worksheet to calculate the January capacity for the hotel. The capacity is calculated by multiplying the occupants per room

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

(cell B3) by the number of rooms in the hotel (cell B2). This result is then multiplied by the Days in Month. Use the range B5:B16 to create a dynamic array for the formula.

3. Enter a dynamic array formula in cell E5 on the **Occupancy** worksheet to calculate the occupancy capacity of the hotel. Your formula should divide the Hotel Capacity into the Actual Capacity. Format your result to a percentage with two decimal places.
4. In cell C17, add the total Hotel Capacity. In D17 add the Actual Occupancy, and in cell F17 add the total Cleaning Expenses
6. In cell E17 create a formula that divides the total actual occupancy by the total hotel occupancy
7. Format the Cleaning Expenses column with a $ in the top and total rows. The rest should be formatted with comma and zero decimal places.
8. On the Cost Analysis worksheet, enter a function into cell B3 that shows the highest value in the Actual Occupancy range on the Occupancy worksheet.
9. On the Cost Analysis worksheet, enter a function into cell B4 that shows the lowest value in the Actual Occupancy column on the Occupancy worksheet.
10. On the Cost Analysis worksheet, enter a function into cell C3 that shows the highest value in the Cleaning Expense column on the Occupancy worksheet.
11. On the Cost Analysis worksheet, enter a function into cell C4 that shows the lowest value in the Cleaning Expense column on the Occupancy worksheet.
12. On the Cost Analysis worksheet, format cells B3, B4 and C4 with a comma and zero decimal places
13. Format cells C3 with US dollars with zero decimal places
14. On the Cost Analysis worksheet, enter a formula in cell B5 that subtracts the lowest actual occupancy value from the highest actual occupancy value. Copy this formula and paste it into cell C5.
15. Enter a formula in cell C6 on the Cost Analysis worksheet that calculates that variable cost portion for the cleaning expenses per month. As mentioned in the introduction to this exercise, the cleaning expense contains costs that increase with each room that is cleaned. This is known as a variable expense and can be estimated by dividing the Actual Occupancy High Low Difference (cell B5) into the Cleaning Expenses High Low Difference (cell C5). Format the output of this formula to US dollars with two decimal places.
16. Enter a formula in cell C7 on the Cost Analysis worksheet that calculates the fixed cost portion for the cleaning expenses per month. This is the amount of money that will be spent on cleaning expenses no matter how many rooms are cleaned. Since we have calculated the variable cost portion of the cleaning expense, we can now use it to calculate the fixed expense. To do this, subtract from the High Cleaning Expense (cell

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

C3) the result of multiplying the variable expense (cell C6) by the High Actual Occupancy (cell B3). Format the result of the formula to US dollars with zero decimal places.

17. Add the current year to the title in each of the worksheets.
18. Save the workbook by adding your name in front of the current workbook name(i.e., "your name Chapter 2 CiP Exercise 2
19. Close the workbook and Excel.

Figure 2.52 Completed CiP Exercise 2 Historical Costs Worksheet

C6 | =B6:B17*B2*B3

	A	B	C	D	E	F
1	**Hotel Occupancy and Cleaning Costs**					
2	Number of Rooms	45				
3	Occupants per Room	4				
4						
5	**Month**	**Days in Month**	**Hotel Capacity**	**Actual Occupancy**	**Percent Occupied**	**Cleaning Expenses**
6	January	31	5,580	4,371	78.3%	4,566
7	February	28	5,040	3,715	73.7%	5,542
8	March	31	5,580	2,062	37.0%	5,877
9	April	30	5,400	3,351	62.1%	4,426
10	May	31	5,580	4,124	73.9%	5,986
11	June	30	5,400	5,413	100.2%	5,595
12	July	31	5,580	4,219	75.6%	5,413
13	August	31	5,580	4,640	83.1%	4,053
14	September	30	5,400	3,866	71.6%	5,259
15	October	31	5,580	2,513	45.0%	4,267
16	November	30	5,400	2,513	46.5%	4,104
17	December	31	5,580	5,142	92.2%	4,246
18	**Total**					

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 2.53 Completed CiP Exercise 2 Cost Analysis Worksheet

	A	B	C
1	Hotel Cost Analysis		
2		Actual Occupancy	Cleaning Expenses
3	High	5,413	$ 5,986
4	Low	2,062	$ 4,053
5	High Low Difference	3,351	1,933
6	Variable Cost per Stay		$ 0.58
7	Fixed Cost		$ 2,863

Historical Costs | Cost Analysis | Cleaning Cost Estimates

Financial Function Case Study

Suzy is wanting to purchase a home and is trying to figure out how to arrange the financing for her purchase. This is her first time buying a house and so she is looking at all the financing options available to her. She has a budget she must stay within, so that is a major factor in how she will determine which option to choose. She has savings that she can apply to a down payment. She's not sure if she wants to use all her savings on the down payment. Help her analyze her options by completing the Loan Analysis worksheet. Once a decision has been made about which option to choose, complete the Amortization table for her so she will know how her payments will be applied to interest and principal.
Instructions:
Download the Financial Function Homework file and complete the following instructions.
In the Loan Analysis worksheet:

1. Name cells E3: **Purchase_Price**, E4: **PmtsPerYear**, and J21: **PreferredOption.**
2. In cells E7:E13 calculate the loan amount borrowed. The amount borrowed will be the difference between the purchase price and the down payment applied to the loan.
3. In cells F7:F13 calculate the monthly payment amount under each option using the PMT function. Change the payment so it shows a positive rather than a negative number.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

4. After working through the Calculating Borrowing Costs lecture video, answer the analysis questions below the table using the financial functions learned. (**Goal seek is not acceptable. You must use financial functions**.)

In the Amortization Table worksheet:

1. In B2, use a 3-D cell reference to link to the loan value for option 1 in the Loan Analysis worksheet.
2. In cells B3:B5, link to the appropriate cells from the Loan Analysis worksheet.
3. Name cells B2,B3, and:B5 using the Create from selection option in the Defined Names section of the Formula ribbon. Name cell B4 Payments_Per_Year.
4. Starting in A9 of your amortization table, use the SEQUENCE function to fill the number of payments you will need to make to bring your loan value to 0 by the end of your amortization table. Use the named cells Payments_Per_Year*Years_in_Loan. SEQUENCE will generate the rows needed to bring the loan to 0.
5. Link B9 to your beginning loan value in B2.
6. Create your PPMT, IPMT and remaining balance. (hint: if you add the IPMT and PPMT values together it should equal the Periodic payment.)
7. Complete the amortization schedule. Your ending balance should be 0.

Integrity Check

Starter File: Chapter 2 IC Exercise 3

Difficulty: Level 3 Difficult

The purpose of this exercise is to analyze a worksheet to determine whether there are any integrity flaws. Read the scenario below, then open the Excel workbook related to this exercise. You will find a worksheet in the workbook named **AnswerSheet**. This worksheet is to be used for any written responses required for this exercise.

Scenario

You are the manager of a large do-it-yourself hardware store that is part of a national retail chain. Your assistant manager has constructed a sales and profit budget for the upcoming year. The **Budget** worksheet contains several formulas used to calculate the expected sales and profit dollars for the store by product category. The following is a list of key elements and calculations used on this worksheet:

- Cells shaded in yellow are intended for data entry values. For example, last year's sales results in Column B are typed into the cells. Also, the expected growth rates in Column D and profit percentages in Column E are also typed into the cells. These values fluctuate from year to year, and the assistant manager intends to create a few scenarios

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

for the budget by changing the growth rates and expected profit percentages for each product category.

- Table 2.9 "Formulas Used on the Budget Worksheet" contains a list of the formulas that are used to produce the outputs on the **Budget** worksheet.

Table 2.9 Formulas Used on the Budget Worksheet

Purpose	Formula	Locatio
Budgeted Profit	Budgeted Sales × Profit Percent	F4:F7
Budgeted Sales	Sales Last Year × (1 + Sales Growth)	C4:C7
Total Profit Growth	(Total Budgeted Profit Dollars ÷ Total Budgeted Sales)	E8
Total Sales Growth	(Total Budgeted Sales − Total Sales Last Year) ÷ Total Sales	D8

1. As noted in Table 2.9 "Formulas Used on the Budget Worksheet", the Sales Last Year is used in the formula calculating the Budgeted Sales dollars. Use the Trace Dependents command to locate the formula referencing any value in the Sales Last Year column on the **Budget** worksheet. Document your observation in the **Answer Sheet** worksheet.
2. The assistant manager intends to use the **Budget** worksheet to create a few scenarios for the budgeted sales and profit dollars. Change a few values in the Profit Percent column and document your observations in the **AnswerSheet** worksheet.
3. Look at each value in the Totals row (row 8) on the **Budget** worksheet. Are there any values that do not make sense? Type your answer on the **AnswerSheet** worksheet.
4. Using Table 2.9 "Formulas Used on the Budget Worksheet" as a guide, evaluate all formulas that were entered into the **Budget** worksheet. Make any necessary corrections to the worksheet so when any value is changed in Columns B, D, and E, new outputs are created.
5. Save the workbook by adding your name in front of the current workbook name.

Integrity Check

Starter File: Chapter 2 IC Exercise 4

Difficulty: Level 3 Difficult

The purpose of this exercise is to analyze a worksheet to determine whether there are any integrity flaws. Read the scenario below, then open the Excel workbook related to this exercise. You will find a worksheet in the workbook named **AnswerSheet**. This worksheet is to be used for any written responses required for this exercise.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Scenario

Your friend is working on a few financial calculations in Excel and is asking for your assistance. The workbook that was given to you contains calculations for estimating the future value of investments and monthly mortgage calculations for purchasing a home. Your friend explained the following in an e-mail that was sent with the workbook:

You will see in the **Investment Plan** worksheet that I have estimated the value of my investments in 5 years. My company is deducting money from my paycheck at the end of every month and investing it in the funds I have listed in Column A. I am pretty sure I did this right, but all my results in Column E are negative. I am not sure why this is happening.

- In the **Mortgage Payments** worksheet, I am trying to calculate the monthly payments for a house I am thinking about buying. However, the output of the function in cell B6 seems high. There is no way I would be paying over $9,000 a month in mortgage payments. Something must be wrong.
- I don't want to spend more than $775 a month for a mortgage. I thought I would be able to use Excel to determine what my target price for the house should be. My agent said that the current owners were probably willing to negotiate on the asking price for the house.

Assignment

Look at the FV function that was entered into cell E3 on the Investment Plan worksheet. Why is the output for this function negative?

Assume that the output of the FV function in cell E3 was a positive $17,385 instead of negative.

Does it make sense that given a 4.5% annual rate of return, starting balance of $10,000, and an ongoing investment of $900 per month that the value of the investment would be $17,385 after 5 years?

1. Look at the PMT function in cell B6 on the **Mortgage Payments** worksheet. Is the function set up to calculate monthly payments?
2. Your friend states that the target monthly mortgage payment is $775. What Excel tool could you use to change the price in cell B2 on the **Mortgage Payments** worksheet, so the mortgage payment is equal to $775?
3. Based on your friend's comments, make any necessary corrections to all the functions in the Investment Plan and **Mortgage Payments** worksheets. Set the price of the home in cell B2 on the **Mortgage Payments** worksheet so the monthly payment equals $775.
4. Save the workbook by adding your name in front of the current workbook name.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Applying Excel Skills

Lease vs. Buy

Starter File: None

Difficulty: Level 2 Moderate

You are in the process of getting a new car but are not sure if you should buy or lease it. The price of the car you want is $28,000, but you do not want to spend more than $350 a month on car payments. If you lease the car, the terms of the lease will be 48 months at an annual interest rate of 5%. The residual value of the car will be set at $19,000. If you buy the car, your bank will offer you a 7-year loan at an annual interest rate of 6%. You are not required to make a down payment with either the lease or loan options, and payments are made at the end of the month for both options.

Should you lease or buy the car given your budget limit of $350 a month? Create a new workbook and design a worksheet that shows the difference between leasing and buying the car in terms of monthly payments. Use proper formatting so your worksheet is easy to read. Remember to:

- name cells and ranges and use them in your functions and formulas.
- use column and row headings,
- add a title to your worksheet, and
- rename the worksheet tab with an appropriate label.
- Include your name in the file name of the workbook.

Amortization Table for a Home Loan

Starter File: None

Difficulty: Level 3 Difficult

You are considering the purchase of a new home offered at a price of $225,000. Create an amortization table in a new workbook that shows how much interest and principal you will pay each month for the duration of the loan. The following is a list of assumptions and requirements you need to consider for this assignment:

1. You will be making a down payment of 20% on the home (refer to Table 2.5 "Key Terms for Loans and Leases" for loan and lease terms).
2. The bank will offer you a loan at an annual interest rate of 5.5% for 30 years.
3. Your mortgage payments will be made at the end of each month.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

4. You must construct the amortization table so that any change in the loan variables, down payment percent, length of loan, interest rate, and so on will automatically produce new outputs for each month of the amortization table.
5. The amortization table must show the interest payment, principal payment, and balance remaining to be paid on the loan for every month of the loan duration. The beginning balance for the last month of the loan should be equal to the principal payment in the last month. Refer to Figure 2.29 "Example of an Amortization Table" for establishing the format for the table.
6. Remember to use column and/or row headings, add a title to your worksheet, and rename the worksheet tab with an appropriate label.
7. Include your name in the file name of the workbook.

CHAPTER SKILLS TEST

Starter File: Chapter 2 Skills Test

Difficulty: Level 2 Moderate

Answer the following questions by executing the skills on the starter file required for this test. Answer each question in the order in which it appears. If you do not know the answer, skip to the next question. Whenever you are using a range, either use a named range or a dynamic array.

Open the starter file listed above before you begin this test.

1. Name cells and ranges and use them in your functions and formulas.
2. Enter a function in cell B9 on the **Investments** worksheet that calculates the total of the values in the range B3:B8.
3. Copy the function in cell B9 and paste it into cells C9 and G9.
4. Enter a formula in cell E3 on the **Investments** worksheet that calculates the growth rate for the investments. Your formula should first subtract the value in the Invested Principal column from the value in the Current Balance column. Then, divide this result by the value in the Invested Principal column. When you hit enter the formula should automatically fill through E8
5. In cell E9 use a formula to calculate the average growth rate.
6. Enter a formula in cell D3 on the **Investments** worksheet that divides the Current Balance by the total in cell C9. When you hit enter the formula should automatically fill through D8
7. In cell G3 on the **Investments** worksheet, use the Future Value function to calculate the future value of the investment in 2 years. Use the Target Growth Rate to define the Rate argument. This is not an annuity so there are no periodic investments. Use the Current

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Balance to define the Pv argument. Assume that the investment is made at the beginning of the period.

8. Copy the function in cell G3 and paste it into the range G4:G8.
9. Enter a function in cell B10 on the **Investments** worksheet that calculates the average of the values in the range B3:B8.
10. Copy the function in cell B10 and paste it into cells C10 and G10.
11. On the **Mortgage** worksheet, use the data provided to enter a formula in cell B6 to calculate the principal of the loan that will be required to purchase the house.
12. On the **Mortgage** worksheet, use the PMT function in cell B7 to calculate the **monthly** payments of the mortgage. Use cell locations from this worksheet to define each argument of the function. Assume that payments are made at the end of each month.
13. On the **Auto Lease** worksheet, use the PMT function in cell B6 to calculate the **monthly** lease payments. Use cell locations from this worksheet to define each argument of the function. Assume that the lease payments are due at the beginning of each month. In cell E2 on the **Summary** worksheet, use a cell reference to display the value in cell B9 in the **Investments** worksheet.
14. In cell E3 on the **Summary** worksheet, use a cell reference to display the value in cell G9 in the **Investments** worksheet.
15. Enter a formula in cell F4 on the **Summary** worksheet that subtracts the Principal of Investments from the 2 Year Future Value of Investments.
16. Enter a formula in cell F5 on the **Summary** worksheet that calculates the amount of mortgage payments that will be made over 2 years. Your formula should multiply the value in B7 on the **Mortgage** worksheet by 24.
17. Enter a formula in cell F6 on the **Summary** worksheet that calculates the amount of lease payments that will be made over 2 years. Your formula should multiply the value in B6 on the **Auto Lease** worksheet by 24.
18. Enter a formula in cell F7 on the **Summary** worksheet that subtracts the sum of the values in the range F5:F6 from the value in cell F4.
19. Sort the data in the range A2:G8 on the **Investments** worksheet. Sort the data based on the values in the Invested Principal column in ascending order (smallest to largest). For duplicate values in this column, sort using the values in the Target Growth Rate column in descending order (largest to smallest).
20. Save the workbook by adding your name in front of the current workbook name (i.e., "your name Chapter 2 Skills Test").

Chapter 3

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Logical and Lookup Functions

Going beyond the basic computational tools of Excel unlocks unlimited potential for processing and analyzing data. This chapter takes you beyond basic Excel computations by introducing *logical functions* and *lookup functions*. Logical functions are used to assess the contents within cell locations and produce custom outputs or mathematical computations. We will look at two types of logical functions in this chapter. The first is the IF function, which uses a logical test to evaluate the contents in a cell location. The OR and AND functions also use logical tests to evaluate the contents in a cell location and are often used within the IF function. The second type of logical function that we will look at are statistical IF functions. These functions combine the logical test feature of the IF function with the mathematical computation features of statistical functions (which were reviewed in Chapter 2 "Mathematical Computations"). The last section of this chapter demonstrates the use of two lookup functions. These functions are used to find data in one worksheet and display it in another. We will demonstrate the skills for this chapter through the construction of a personal investment portfolio.

This theme builds on the personal budget project introduced in Chapter 2 "Mathematical Computations". In the personal budget project, we analyzed the impact of investing money in an account that provides a continuous rate of return. In this chapter, we look at how you can decide where to invest your money and how to analyze the performance of those investments.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

3.1 Logical Functions

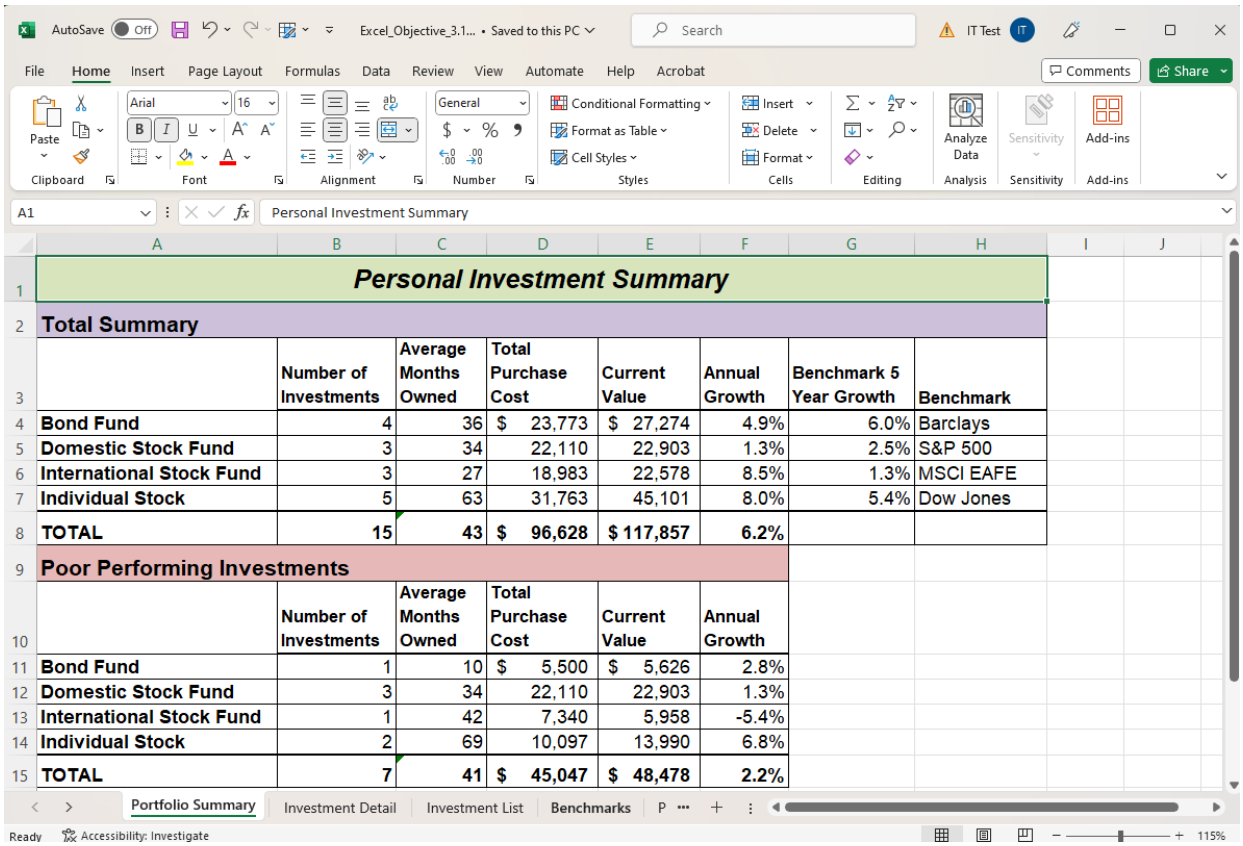
LEARNING OBJECTIVES
1. Learn how to use the Freeze Panes command to lock specific columns and rows in place while scrolling through large worksheets.
2. Understand the construction and use of formulas, basic statistical functions, and financial functions.
3. Learn how to construct a logical test to evaluate the contents of a cell location.
4. Learn how to use the IF function to evaluate the data in a cell location using a logical test.
5. Learn how to use the OR function within an IF function to evaluate the data in a cell location using multiple logical tests.
6. Learn how to use the AND function within an IF function to evaluate the data in a cell location using multiple logical tests.
7. Review the construction of nested IF functions for evaluating data using more than one logical test.
8. Learn how to set a conditional format rule so formatting commands are automatically applied based on the value in a cell location.

This section reviews the use of logical functions in Excel through the construction of an investment portfolio. Although it may seem that managing investments is a specialized career choice, the reality is that almost everyone will become an investor at some point in their lives. Many companies offer employees retirement savings benefits through 401(k) or 403(b) plans. These plans allow you to deduct money from your paycheck every month, tax-free, and invest it. In addition to the tax benefits afforded by such plans, many employers match a percentage of your monthly savings or deposit money into your retirement account as an added form of compensation. When you sign up for these savings plans, your company will give you a list of options as to how your money can be invested, and you choose the type of investments you would like the company to make on your behalf. Because of this process, you become an investor. Excel can be an extremely valuable tool to help you make these investment decisions and analyze the performance of the money you have invested.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.1 "Completed Personal Investment Portfolio Workbook" shows the completed investment portfolio workbook that we will complete in this chapter. Like the personal budget example in Chapter 2 "Mathematical Computations", the Portfolio **Summary** worksheet contains a summary of the data entered or calculated in other worksheets in the workbook. This project begins by building on the **Investment Detail** worksheet.

Figure 3.1 Completed Personal Investment Portfolio Workbook



Personal Investment Summary

Total Summary

	Number of Investments	Average Months Owned	Total Purchase Cost	Current Value	Annual Growth	Benchmark 5 Year Growth	Benchmark
Bond Fund	4	36	$ 23,773	$ 27,274	4.9%	6.0%	Barclays
Domestic Stock Fund	3	34	22,110	22,903	1.3%	2.5%	S&P 500
International Stock Fund	3	27	18,983	22,578	8.5%	1.3%	MSCI EAFE
Individual Stock	5	63	31,763	45,101	8.0%	5.4%	Dow Jones
TOTAL	15	43	$ 96,628	$ 117,857	6.2%		

Poor Performing Investments

	Number of Investments	Average Months Owned	Total Purchase Cost	Current Value	Annual Growth
Bond Fund	1	10	$ 5,500	$ 5,626	2.8%
Domestic Stock Fund	3	34	22,110	22,903	1.3%
International Stock Fund	1	42	7,340	5,958	-5.4%
Individual Stock	2	69	10,097	13,990	6.8%
TOTAL	7	41	$ 45,047	$ 48,478	2.2%

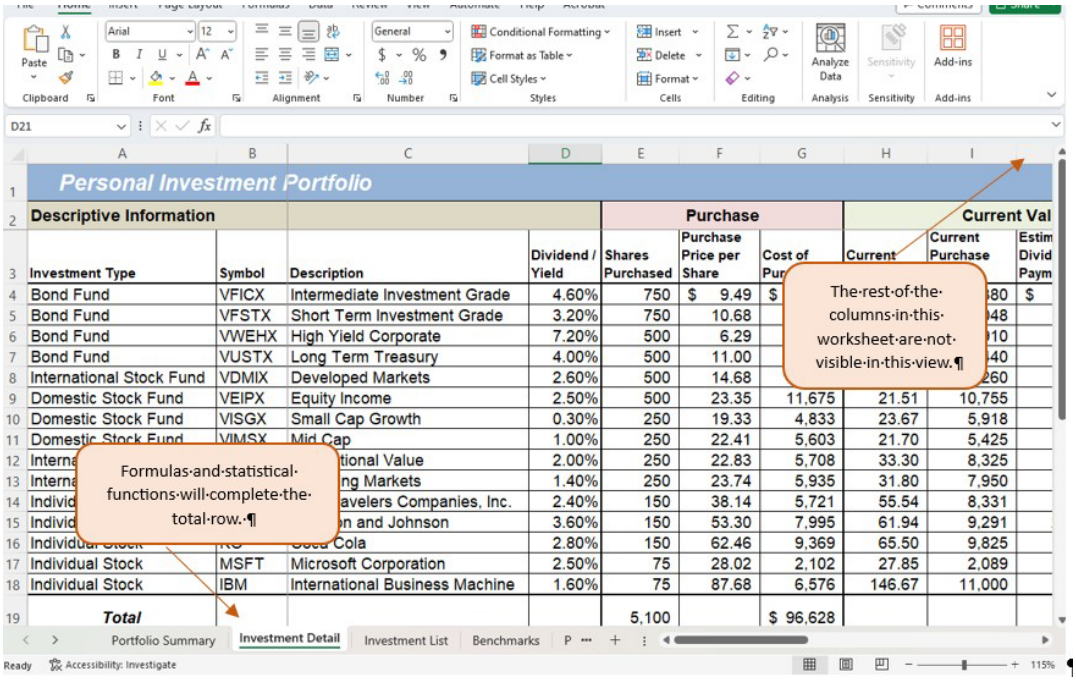
Freeze Panes

Follow-along file: Excel Objective 3.00

The **Investment Detail** worksheet shown in Figure 3.2 "Investment Detail Worksheet" contains the majority of the information used to create the **Portfolio Summary** worksheet shown in Figure 3.1 "Completed Personal Investment Portfolio Workbook". When you first open the worksheet, you will notice it is not possible to view all twenty-four columns on your computer screen. As you scroll to the right to view the rest of the columns, you will lose site of the row headings in Columns A and B. The headings in these columns show the investment that pertains to the data in Columns C through X. To solve this problem of viewing the row headings while scrolling through the remaining columns in the worksheet, we will use the Freeze Panes command.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.2 Investment Detail Worksheet

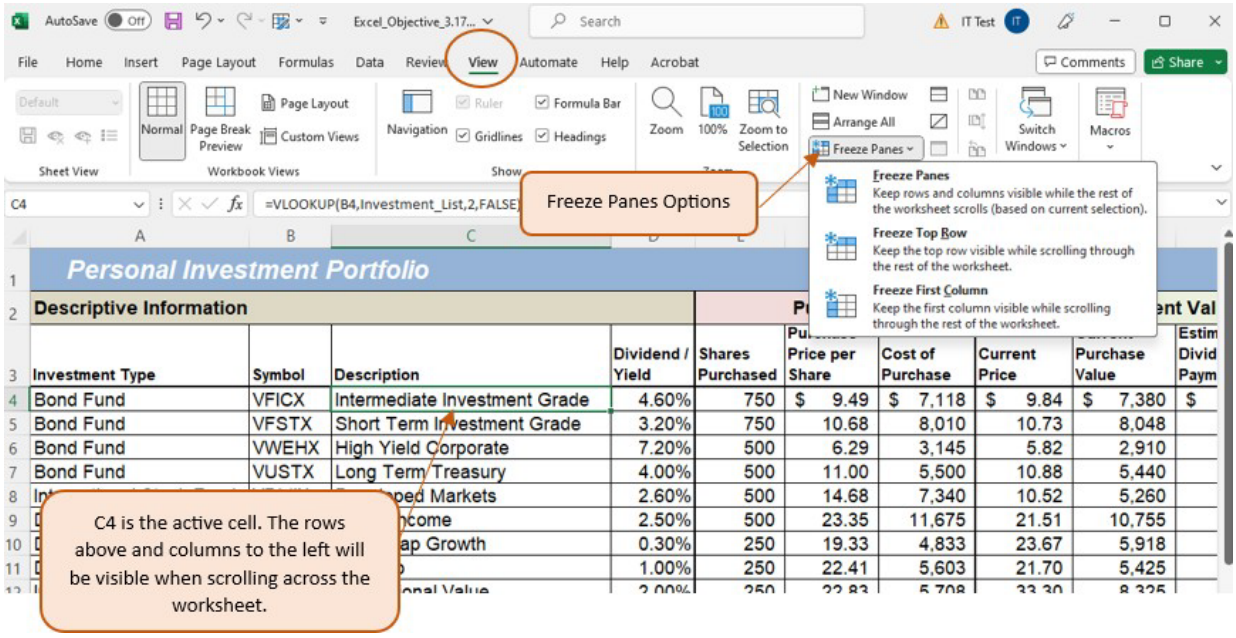

Personal Investment Portfolio
Descriptive Information
Purchase
Current Val
Investment Type
Symbol
Description
Dividend / Yield
Shares Purchased
Purchase Price per Share
Cost of Pur
Current
Current Purchase
Estim Divid Paym
Bond Fund VFICX Intermediate Investment Grade 4.60% 750 $ 9.49 $
Bond Fund VFSTX Short Term Investment Grade 3.20% 750 10.68
Bond Fund VWEHX High Yield Corporate 7.20% 500 6.29
Bond Fund VUSTX Long Term Treasury 4.00% 500 11.00
International Stock Fund VDMIX Developed Markets 2.60% 500 14.68
Domestic Stock Fund VEIPX Equity Income 2.50% 500 23.35 11,675 21.51 10,755
Domestic Stock Fund VISGX Small Cap Growth 0.30% 250 19.33 4,833 23.67 5,918
Domestic Stock Fund VIMSX Mid Cap 1.00% 250 22.41 5,603 21.70 5,425
2.00% 250 22.83 5,708 33.30 8,325
1.40% 250 23.74 5,935 31.80 7,950
2.40% 150 38.14 5,721 55.54 8,331
3.60% 150 53.30 7,995 61.94 9,291
2.80% 150 62.46 9,369 65.50 9,825
Individual Stock MSFT Microsoft Corporation 2.50% 75 28.02 2,102 27.85 2,089
Individual Stock IBM International Business Machine 1.60% 75 87.68 6,576 146.67 11,000
Total 5,100 $ 96,628
The rest of the columns in this worksheet are not visible in this view.
Formulas and statistical functions will complete the total row.
Portfolio Summary
Investment Detail
Investment List
Benchmarks
Ready
Accessibility: Investigate

The Freeze Panes command allows you to scroll across the **Investment Detail** worksheet while keeping the row headings in Columns A and B locked in place. The following steps explain how to do this:

1. Click cell C4 on the **Investment Detail** worksheet. We select this cell because the Freeze Panes option locks the columns to the left of the activated cell as well as the rows above the activated cell.
2. Click the View tab on the Ribbon.
3. Click the Freeze Panes button (see Figure 3.3 "Freeze Panes Command").
4. Click the Freeze Panes option from the drop-down list of options.

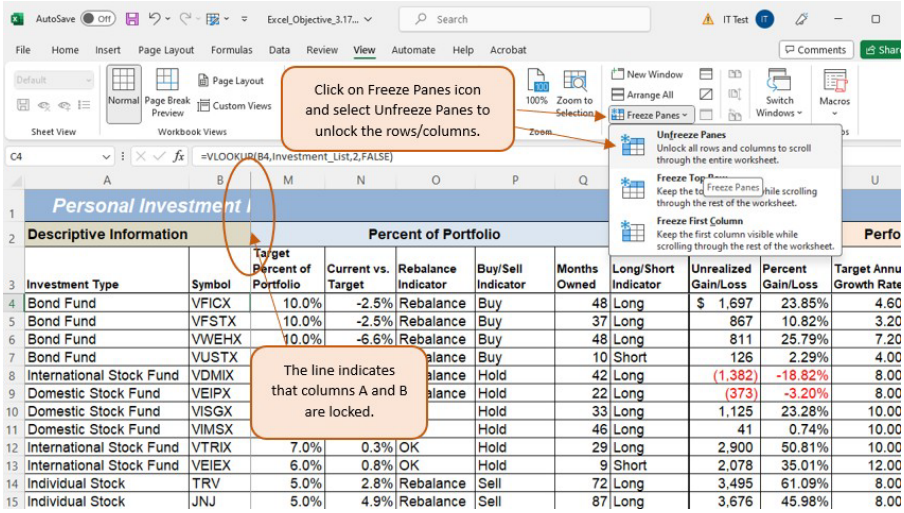
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.3 Freeze Panes Command


Freeze Panes Options
Freeze Panes
Keep rows and columns visible while the rest of the worksheet scrolls (based on current selection).
Freeze Top Row
Keep the top row visible while scrolling through the rest of the worksheet.
Freeze First Column
Keep the first column visible while scrolling through the rest of the worksheet.
C4 is the active cell. The rows above and columns to the left will be visible when scrolling across the worksheet.

Once you click the Freeze Panes option, Columns A and B are locked in place as you scroll through the columns in the worksheet. Since this is a large worksheet, you may find it easier to navigate the columns by using the arrow keys on your keyboard. However, since rows 1 and 2 contain merged cells, *make sure a cell location is activated below Row 2before you begin using the arrow keys*. Figure 3.4 "Freeze Panes Command Activated on the Investment Detail Worksheet" shows the appearance of the **Investment Detail** worksheet after the Freeze Panes command has been activated. To deactivate the Freeze Panes command, click the Freeze Panes button again and select the Unfreeze Panes option.

Figure 3.4 Freeze Panes Command Activated on the Investment Detail Worksheet


Click on Freeze Panes icon and select Unfreeze Panes to unlock the rows/columns.
Unfreeze Panes
Unlock all rows and columns to scroll through the entire worksheet.
The line indicates that columns A and B are locked.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Formula and Functions Review

Follow-along file: Continue with Excel Objective 3.00. (Use file Excel Objective 3.01 if starting here.) We will begin developing the personal investment portfolio workbook by adding several formulas and functions. The formulas and functions we will add were illustrated in detail in Chapter 2 "Mathematical Computations". Therefore, the steps provided in this chapter will be brief. After the formulas and functions are added to the **Investment Detail** worksheet, we can add the logical and lookup functions.

However, before proceeding, let's review the investment type definitions in Table 3.1 "Investment Types in Column A of the Investment Detail Worksheet". Table 3.1 "Investment Types in Column A of the Investment Detail Worksheet" provides a definition for each of the investment types listed in Column A of the **Investment Detail** worksheet. This project assumes that the personal investment portfolio comprises four types of investments. The reason we include a variety of investment types in any portfolio is to manage our total risk, or potential of losing money. When building an investment portfolio, it is important to keep in mind that investments of all types can dramatically increase or decrease in value over a short period of time. Managing risk requires that your money is not concentrated in one type of investment.

Table 3.1 Investment Types in Column A of the Investment Detail Worksheet

Category	Definition
Bond Fund	A mutual fund consisting of a variety of bonds. The benefit of buying shares of a fund as opposed to a specific bond is that doing so allows you to spread your investment over several bonds instead of concentrating your investment in just one bond.
Domestic Stock Fund	A mutual fund consisting of several domestic stocks. Buying shares of a stock mutual fund provides the benefit of investing your money over several stocks.
International Stock Fund	Same as a domestic stock fund but contains a variety of non-US or foreign stocks.
Individual Stock	The stock for one specific company. In addition to mutual funds, this chapter's portfolio will include a few individual stocks for public companies. When you purchase shares of a specific company, such as IBM, you become a partial owner of that company.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

We will add formulas and functions to the **Investment Detail** worksheet in sections. If you scroll across all the columns in the worksheet, you will notice the worksheet includes five distinct sections. Four of the five sections contain columns that need to be completed with formulas and functions before we can add the logical andlookup functions. Table 3.2 "Definitions for Columns A through G of the Investment Detail Worksheet" contains definitions for each of the columns in the Descriptive Information section (Columns A through D) and the Purchase section (Columns E through G). It will be helpful to understand the purpose of these columns as we complete thisworksheet.

Table 3.2 Definitions for Columns A through G of the Investment Detail Worksheet

Category	Definition
Investment Type	The type of investment regarding bonds and stocks. A definition for each of the investment types used in this portfolio can be found in Table 3.1 "Investment Types in Column A of the Investment Detail Worksheet".
Symbol	The symbol that represents a mutual fund or stock. This symbol can be used to research the profile or current trading price on any website that provides stock quotes.
Description	The company name for an individual stock or a description of the type of investments made by a mutual fund.
Dividend/Yield	The amount of interest earned on a bond or bond fund or the amount of earnings distributed per share for an individual stock or stock fund.
Shares Purchased	The number of shares purchased for a mutual fund or individual stock.
Purchase Price per Share	The price paid for the shares purchased for the mutual funds and individual stocks in the portfolio.
Cost of Purchase	The number of shares purchased multiplied by the purchase price per share. This represents your base investment and is used to determine how much money has been gained or lost.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

The Descriptive Information section of the **Investment Detail** worksheet (Columns A through D) contains only one blank column, which will be completed using a lookup function. Therefore, we will proceed to the Purchase section (Columns E through G) where the Cost of Purchase column is blank. The following steps explain how to enter the formula into this column:

1. Click cell G4 on the **Investment Detail** worksheet.
2. Type an equal sign (**=**).
3. Enter a formula that multiplies the Shares Purchased (E4:E18) by the Purchase Price per Share (F4:F18). (Using dynamic arrays)
4. Highlight the range G5:G18 and format the cells for comma with no decimal places.
5. Click cell E19 on the **Investment Detail** worksheet.
6. Press and hold the ALT key on your keyboard, then press the equal sign (**=**). This is the shortcut for the Auto Sum feature.
7. Press the ENTER key on your keyboard.

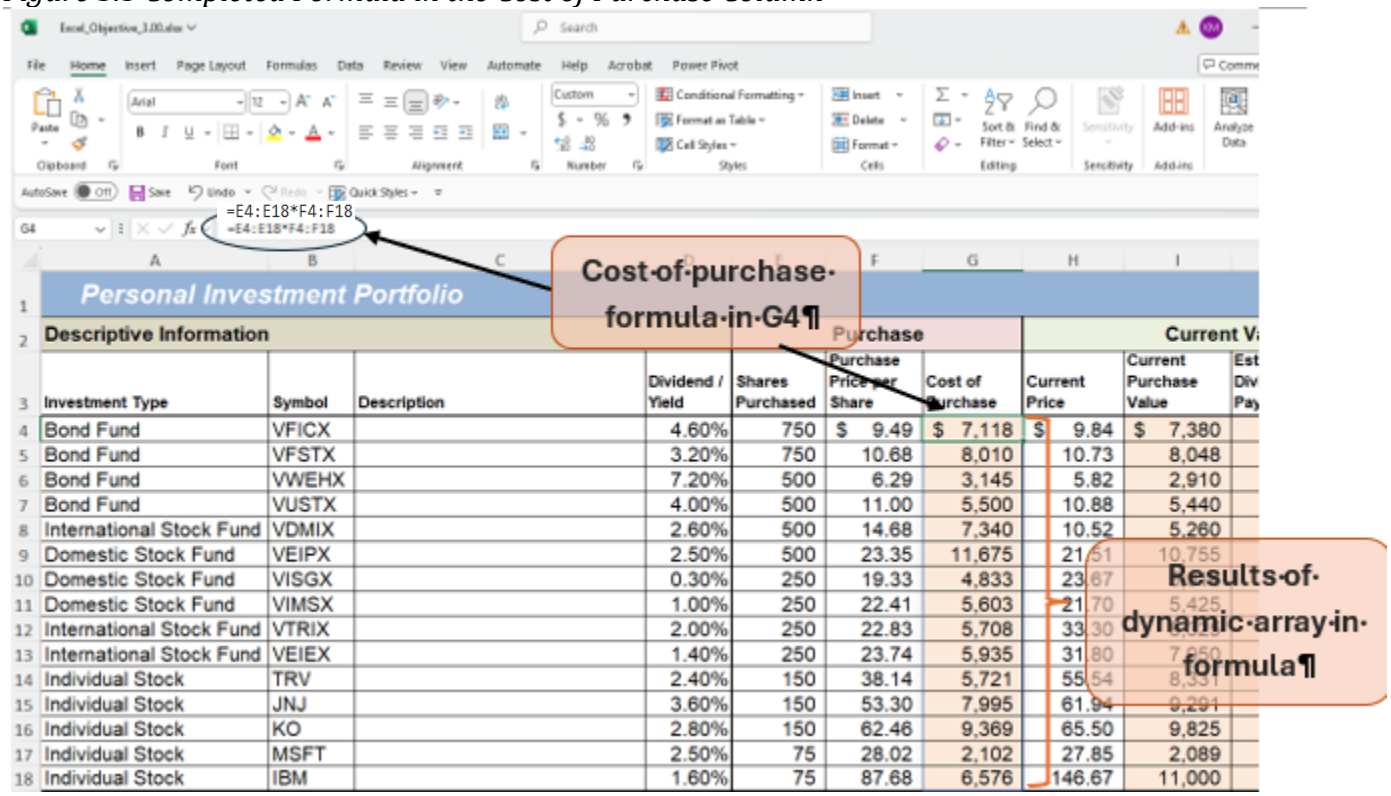
Keyboard Shortcuts- AutoSum
Press and hold the ALT key on your keyboard, then press the equal sign (=)

8. Click cell G19 on the **Investment Detail** worksheet.
9. Repeat step 9.
10. Press the ENTER key on your keyboard.

Figure 3.5 "Completed Formula in the Cost of Purchase Column" shows the formula that was entered into cell G4 in the Purchase section of the **Investment Detail** worksheet. You can see the grayed-out results of the formula in the range G5:G18. Using dynamic arrays does not alter borders and formatting.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.5 Completed Formula in the Cost of Purchase Column



	A	B	C	D	E	F	G	H	I
1	Personal Investment Portfolio								
2	Descriptive Information					Purchase		Current V	
3	Investment Type	Symbol	Description	Dividend / Yield	Shares Purchased	Purchase Price per Share	Cost of Purchase	Current Price	Current Purchase Value
4	Bond Fund	VFICX		4.60%	750	$ 9.49	$ 7,118	$ 9.84	$ 7,380
5	Bond Fund	VFSTX		3.20%	750	10.68	8,010	10.73	8,048
6	Bond Fund	VWEHX		7.20%	500	6.29	3,145	5.82	2,910
7	Bond Fund	VUSTX		4.00%	500	11.00	5,500	10.88	5,440
8	International Stock Fund	VDMIX		2.60%	500	14.68	7,340	10.52	5,260
9	Domestic Stock Fund	VEIPX		2.50%	500	23.35	11,675	21.51	10,755
10	Domestic Stock Fund	VISGX		0.30%	250	19.33	4,833	23.67	
11	Domestic Stock Fund	VIMSX		1.00%	250	22.41	5,603	21.70	5,425
12	International Stock Fund	VTRIX		2.00%	250	22.83	5,708	33.30	
13	International Stock Fund	VEIEX		1.40%	250	23.74	5,935	31.80	
14	Individual Stock	TRV		2.40%	150	38.14	5,721	55.54	
15	Individual Stock	JNJ		3.60%	150	53.30	7,995	61.94	
16	Individual Stock	KO		2.80%	150	62.46	9,369	65.50	9,825
17	Individual Stock	MSFT		2.50%	75	28.02	2,102	27.85	2,089
18	Individual Stock	IBM		1.60%	75	87.68	6,576	146.67	11,000

Table 3.3 "Definitions for Columns H through K of the Investment Detail Worksheet" shows the definitions for the Current Value section (Columns H through K) of the **Investment Detail** worksheet.

Table 3.3 Definitions for Columns H through K of the Investment Detail Worksheet

Category	Definition
Current Price	The current price of an individual stock or the current net asset value of a mutual fund.
Current Purchase Value	The number of shares purchased multiplied by the current price.
Estimated Dividend Payments	The estimated amount of money paid for the interest on a bond fund, or the dividends paid on a stock or stock fund. The future value function is used to estimate these payments. For an actual portfolio, real monetary distributions can be added to the current purchase value of the investment to calculate the total value of an investment.
Current Investment Value	The current purchase value plus the estimated dividend payments. The current investment value is compared with the cost of purchase to determine how much money is gained or lost.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

We will add a basic formula to the Current Purchase Value and Current Investment Value columns. For the Estimated Dividend Payments column, we will use the FV (future value) function to estimate the dividend payments. The rate for the dividend payments comes from the anticipated dividend yield column (D) The following explains how we add the FV function to the Estimated Dividend Payments column:

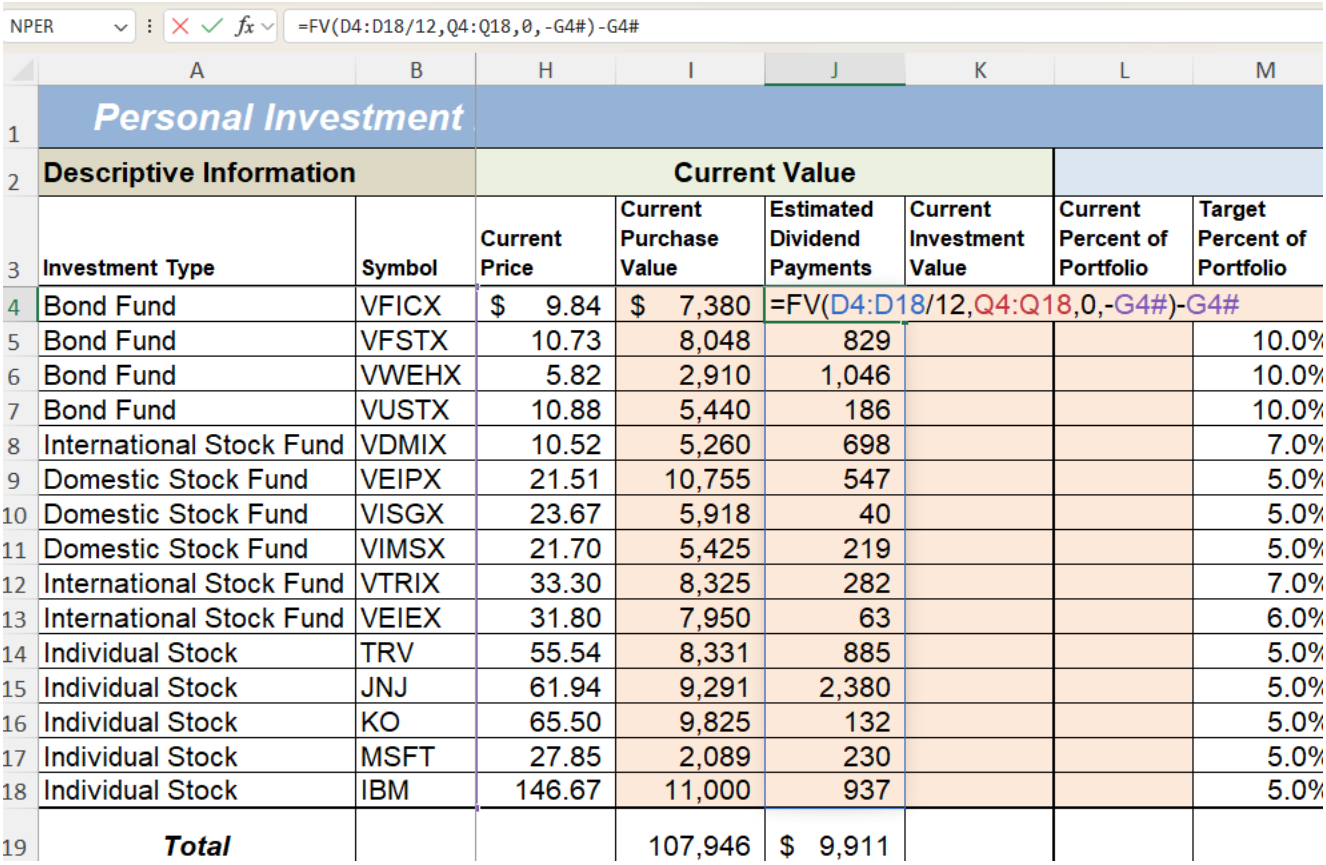
1. Click cell J4 and type an equal sign (=).
2. Type the function name FV followed by an open parenthesis (().
3. For the Rate argument, we will use the Dividend Yield range D4:D18 divided by 12 months. Select the range D4:D18. type a forward slash (/) for division and then type 12. This divides the rate in the Dividend Yield column by 12. The length of ownership of an investment is expressed in terms of months in Column Q. Therefore, the rate for the FV function must be expressed in terms of months by dividing the annual rate by 12.
4. Type a comma.
5. For the Nper we will use the Months Owned from column Q, which contains the number of months owned or the term of the future value calculation. Select the range Q4:Q18.
6. Type a comma followed by a zero (,0). We are not calculating an annuity or periodic investment in this example, so the PMT argument will be defined with a zero. Type a comma to advance the function to the Pv argument.
7. For the PV argument, we will use the Cost of Purchase previously calculated in column G. Type a minus sign (−) and start typing cost. Double click on the named range when it appears in the drop-down selection box. This is the cost of the investment purchase.
8. Type a closing parenthesis). This creates a function using dynamic arrays that will adjust automatically when we add the next step.
9. By itself, the FV function is calculating the total value of the investment with dividends or interest earned. To show only the amount of dividends or interest earned, we subtract the cost of the investment purchase in the range G4:G18 from the result of the FV function. Type a minus sign (−) and select the range G4:G18.
10. Press the ENTER key on your keyboard.
11. Format for comma with 0 decimal places..
12. In J19, sum the column of estimated dividends.

Figure 3.6 "Completed FV Function in the Estimated Dividend Payments Column" shows the completed FV function in cell J4 of the Estimated Dividend Payments column. It is important to reduce the decimal places to zero after you enter the function into cell J4.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Excel does not display the result of the function until the decimal places are removed because of the column width.

Figure 3.6 Completed FV Function in the Estimated Dividend Payments Column



NPER =FV(D4:D18/12,Q4:Q18,0,-G4#)-G4#

	A	B	H	I	J	K	L	M
1	Personal Investment							
2	Descriptive Information		Current Value					
3	Investment Type	Symbol	Current Price	Current Purchase Value	Estimated Dividend Payments	Current Investment Value	Current Percent of Portfolio	Target Percent of Portfolio
4	Bond Fund	VFICX	$ 9.84	$ 7,380	=FV(D4:D18/12,Q4:Q18,0,-G4#)-G4#			
5	Bond Fund	VFSTX	10.73	8,048	829			10.0%
6	Bond Fund	VWEHX	5.82	2,910	1,046			10.0%
7	Bond Fund	VUSTX	10.88	5,440	186			10.0%
8	International Stock Fund	VDMIX	10.52	5,260	698			7.0%
9	Domestic Stock Fund	VEIPX	21.51	10,755	547			5.0%
10	Domestic Stock Fund	VISGX	23.67	5,918	40			5.0%
11	Domestic Stock Fund	VIMSX	21.70	5,425	219			5.0%
12	International Stock Fund	VTRIX	33.30	8,325	282			7.0%
13	International Stock Fund	VEIEX	31.80	7,950	63			6.0%
14	Individual Stock	TRV	55.54	8,331	885			5.0%
15	Individual Stock	JNJ	61.94	9,291	2,380			5.0%
16	Individual Stock	KO	65.50	9,825	132			5.0%
17	Individual Stock	MSFT	27.85	2,089	230			5.0%
18	Individual Stock	IBM	146.67	11,000	937			5.0%
19	***Total***			107,946	$ 9,911			

The following steps explain how to add the formulas for the Current Purchase Value and Current Investment Value columns:

1. Click cell I4 on the **Investment Detail** worksheet.
2. Enter a formula that multiplies the Current Price range H4:H18 by the Shares Purchased the range cell E4:E18. (=H4:H18 * E4:E18)
3. Format for J4 for $ no decimal places and the range J5:J18 for comma with zero decimal places.
4. Click cell K4 on the **Investment Detail** worksheet.
5. Enter a formula that adds the Current Purchase Value in the range I4:I18 to the Estimated Dividend Payments the range J4:J18.
6. Click cell K19 on the **Investment Detail** worksheet.
7. Enter a SUM function that adds the values in the rangeK4:K18.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.7 "Completed Current Value Section of the Investment Detail Worksheet" shows the completed columns of the Current Value section in the **Investment Detail** worksheet. The formula used to calculate the Current Investment Value illustrates why we used the FV function to calculate the estimated dividend or interest payments for an investment.

Investments that earn interest or dividends can achieve growth in two ways. The first way is through interest or dividend payments. The second way is through changes in the price paid for the investment. The formula used to calculate the Current Purchase Value is taking the number of shares purchased for each investment and multiplying it by the current market price.

Therefore, the Current Investment Value considers any changes in the investment price by adding the purchase value at the current market price to any dividends or interest payments earned.

Figure 3.7 Completed Current Value Section of the Investment Detail Worksheet

	A	B	E	F	G	H	I	J	K
1	Personal Investment								
2	Descriptive Information		Purchase			Current Value			
3	Investment Type	Symbol	Shares Purchased	Purchase Price per Share	Cost of Purchase	Current Price	Current Purchase Value	Estimated Dividend Payments	Current Investment Value
4	Bond Fund	VFICX	750	$ 9.49	$ 7,118	$ 9.84	$ 7,380	$ 1,435	$ 8,815
5	Bond Fund	VFSTX	750	10.68	8,010	10.73	8,048	829	8,877
6	Bond Fund	VWEHX	500	6.29	3,145	5.82	2,910	1,046	3,956
7	Bond Fund	VUSTX	500	11.00	5,500	10.88	5,440	186	5,626
8	International Stock Fund	VDMIX	500	14.68	7,340	10.52	5,260	698	5,958
9	Domestic Stock Fund	VEIPX	500	23.35	11,675	21.51	10,755	547	11,302
10	Domestic Stock Fund	VISGX	250	19.33	4,833	23.67	5,918	40	5,958
11	Domestic Stock Fund	VIMSX	250	22.41	5,603	21.70	5,425	219	5,644
12	International Stock Fund	VTRIX	250	22.83	5,708	33.30	8,325	282	8,607
13	International Stock Fund	VEIEX	250	23.74	5,935	31.80	7,950	63	8,013
14	Individual Stock	TRV	150	38.14	5,721	55.54	8,331	885	9,216
15	Individual Stock	JNJ	150	53.30	7,995	61.94	9,291	2,380	11,671
16	Individual Stock	KO	150	62.46	9,369	65.50	9,825	132	9,957
17	Individual Stock	MSFT	75	28.02	2,102	27.85	2,089	230	2,319
18	Individual Stock	IBM	75	87.68	6,576	146.67	11,000	937	11,938
19	***Total***		5,100	433	$ 96,628		107,946	$ 9,911	$117,857

Table 3.4 "Definitions for Columns L through R of the Investment Detail Worksheet" provides definitions for the Percent of Portfolio section of the **Investment Detail** worksheet (Columns L through R).

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Table 3.4 Definitions for Columns L through R of the Investment Detail Worksheet

Category	Definition
Current Percent of Portfolio	The current investment value divided by the total current value of the investment portfolio.
Target Percent of Portfolio	The planned percentage each investment is intended to have for the entire portfolio.
Current vs. Target	The difference between the Current Percent of Portfolio column and the Target Percent of Portfolio column.
Rebalance Indicator	Shows which investments do not match the target percentage of the portfolio. For example, as one investment increases in value due to an increase in market price, it will comprise a greater percentage of the portfolio. This may require that some shares of this asset be sold and invested in other areas that may have decreased in value. This is known as *rebalancing the portfolio*, and it helps you sell investments when prices are high and buy investments when prices are low.
Buy/Sell Indicator	Based on the results of the Rebalance Indicator, a logical function is used to indicate whether an investment should be purchased or sold.
Months Owned	Shows how many months an investment is owned. The length of ownership is expressed in terms of months since dividend payments on stock funds and interest payments on bond funds are distributed monthly.
Long/Short Indicator	Shows whether an investment has been owned long enough to qualify as a long-term investment, which is greater than twelve months. The amount of taxes paid on the amount of money gained for a short-term investment is greater than a long-term investment. Therefore, there is a tax incentive to hold investments for more than twelve months.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

The Percent of Portfolio section of the **Investment Detail** worksheet (Columns L through R) requires two formulas and one function. The following steps explain how we add them to the worksheet:

1. Click on cell K19 and name the cell Total_Current_Value.
2. Click cell L4 in the **Investment Detail** worksheet.
3. In cell K4, enter a formula that divides the Current Investment Value range K4:K18 by the Total_Current_Value in cell K19.
4. Click cell N4 in the **Investment Detail** worksheet.
5. Enter a formula that subtracts the Target Percent of Portfolio (range M4:M18) from the Current Percent of Portfolio (range L4:L18): **L4:L18–M4:M18.**
6. Click cell Q19 in the **Investment Detail** worksheet.
7. Enter an AVERAGE function that calculates the average of the values in the range Q4:Q18.

Figure 3.8 "Percent of Portfolio Section of the Investment Detail Worksheet "shows the results of adding two formulas and a function to the Percent of Portfolio section of the **Investment Detail** worksheet. Notice the absolute reference added to the cell reference for K19 in the formula in the Current Percent of Portfolio column.

Figure 3.8 Percent of Portfolio Section of the Investment Detail Worksheet

	A	B	J	K	L	M	N	O	P	Q
1	Personal Investment									
2	Descriptive Information		Value		Percent of Portfolio					
3	Investment Type	Symbol	stimated ividend ayments	Current Investment Value	Current Percent of Portfolio	Target Percent of Portfolio	Current vs Target	Rebalance Indicator	Buy/Sell Indicator	Months Owned
4	Bond Fund	VFICX	$ 1,435	$ 8,815	7.5%	10.0%	=L4#-M4:M18			48
5	Bond Fund	VFSTX	829	8,877	7.5%	10.0%	-2.5%			37
6	Bond Fund	VWEHX	1,046	[illegible]	[illegible]	10.0%	-6.6%			48
7	Bond Fund	VUSTX	186	[illegible]	[illegible]	0.0%	-5.2%			10
8	International Stock Fund	VDMIX	698	[illegible]	[illegible]	7.0%	-1.9%			42
9	Domestic Stock Fund	VEIPX	547	[illegible]	[illegible]	5.0%	4.6%			22
10	Domestic Stock Fund	VISGX	40	5,958	5.1%	5.0%	0.1%			33
11	Domestic Stock Fund	VIMSX	219	5,644	4.8%	5.0%	-0.2%			46
12	International Stock Fund	VTRIX	282	8,607	7.3%	7.0%	0.3%			29
13	International Stock Fund	VEIEX	63	8,013	6.8%	6.0%	0.8%			9
14	Individual Stock	TRV	885	9,216	7.8%	5.0%	2.8%			72
15	Individual Stock	JNJ	2,380	11,671	9.9%	5.0%				87
16	Individual Stock	KO	132	9,957	8.4%	5.0%				6
17	Individual Stock	MSFT	230	2,319	2.0%	5.0%				50
18	Individual Stock	IBM	937	11,938	10.1%	5.0%				100
19	*Total*		$ 9,911	$117,857						42.6

Current vs. Target formula

Average function output

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Table 3.5 "Definitions for Columns S through X of the Investment Detail Worksheet" provides definitions for the columns in the Performance Analysis section of the **Investment Detail** worksheet.

Table 3.5 Definitions for Columns S through X of the Investment Detail Worksheet

Category	Definition
Unrealized Gain/Loss	The amount of money gained or lost on an investment. It is considered unrealized because the loss or gain does not actually occur until the investment is sold.
Percent Gain/Loss	The percentage increase or decrease based on the unrealized gain/loss and the purchase value of an investment.
Target Annual Growth Rate	The expected annual growth rate for an investment. All investments are expected to grow over time. The rate of growth depends on the amount of risk taken. Investments that are a higher risk are expected to pay a higher rate of return.
Actual Annual Growth Rate	The percentage gain/loss divided by the amount of time an investment is owned expressed in terms of years.
Target vs. Actual Growth Rate	The difference between the actual annual growth rate and the target annual growth rate.
Performance Indicator	A logical function will be used to indicate which investments are underperforming with respect to the target vs. actual growth rate.

Most of the columns in the Performance Analysis section of the **Investment Detail** worksheet will be completed with formulas and functions. The following steps explain how we add them to the worksheet:

1. Click cell S4 on the **Investment Detail** worksheet.
2. Enter a formula in G4 that subtracts the value in the Cost of Purchase column from the value in the Current Investment Value column **K4#–G4#**.
    - Note that this formula will be used to calculate the output for the Total row in this column. The results of the formula show how much money has been earned or lost for each investment. It is important to note that these gains or losses do not actually happen unless the investment is sold.
3. Click cell T4 on the **Investment Detail** worksheet.
4. Enter a formula that divides the Unrealized Gain/Loss by the Cost of Purchase **S4:S18/G4:G18**.
5. Click cell V4 on the **Investment Detail** worksheet.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

6. Enter a formula in V4 that divides the Percent Gain/Loss by the result of dividing the Months Owned by 12: **T4:T18/(Q4:Q18/12)**.

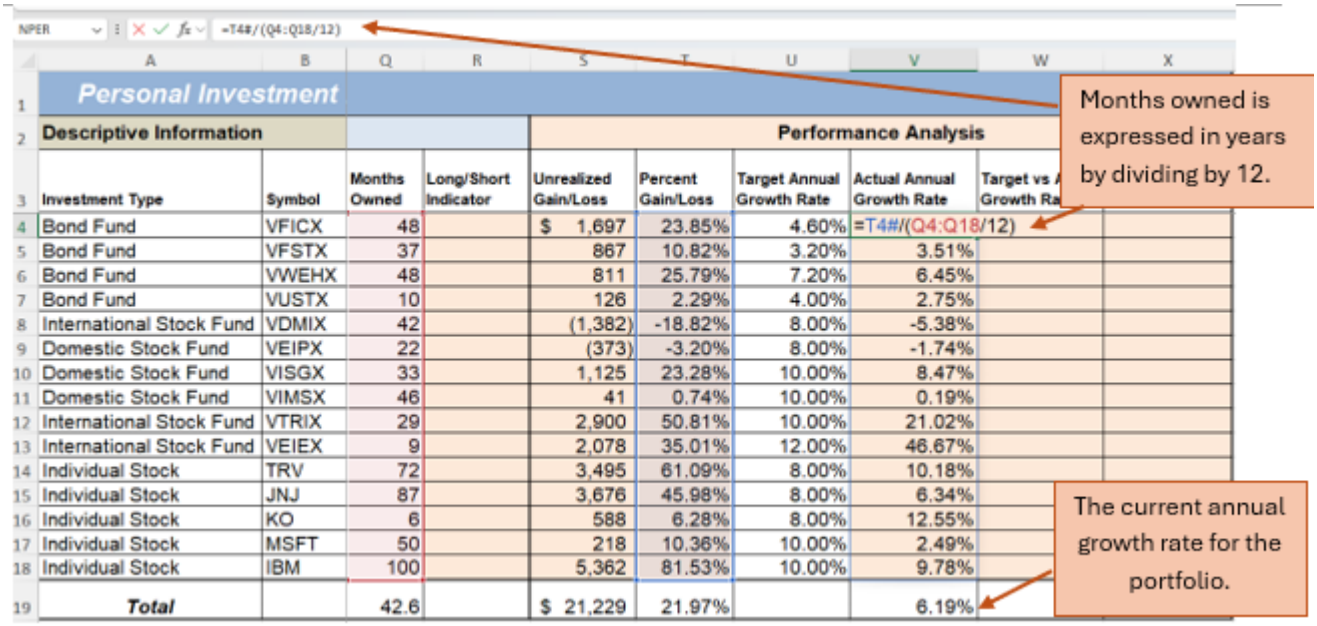
    - Dividing the Months Owned value by 12 expresses the amount of time an investment has been owned in terms of years. The benchmark growth rates for most investments are expressed in terms of annual return rates. Therefore, this formula must first express the amount of time an investment has been owned in terms of years. Then the total percentage gain or loss for each investment is divided by the length of ownership in years to calculate the actual annual rate of return.

7. Click cell W4 on the **Investment Detail** worksheet.

8. Enter a formula that subtracts the Target Annual Growth Rate from the Actual Annual Growth Rate: **V4:18–U4:18**.

Figure 3.9 "Performance Analysis Section of the Investment Detail Worksheet" shows the results of the formulas added to the Performance Analysis section of the **Investment Detail** worksheet. This completes the required formulas and functions necessary to add before moving on to the logical and lookup functions of the chapter.

Figure 3.9 Performance Analysis Section of the Investment Detail Worksheet


NPER
=T4#/(Q4:Q18/12)
Personal Investment
Descriptive Information
Performance Analysis
Investment Type
Symbol
Months Owned
Long/Short Indicator
Unrealized Gain/Loss
Percent Gain/Loss
Target Annual Growth Rate
Actual Annual Growth Rate
Bond Fund VFICX 48 $ 1,697 23.85% 4.60% =T4#/(Q4:Q18/12)
Bond Fund VFSTX 37 867 10.82% 3.20% 3.51%
Bond Fund VWEHX 48 811 25.79% 7.20% 6.45%
Bond Fund VUSTX 10 126 2.29% 4.00% 2.75%
International Stock Fund VDMIX 42 (1,382) -18.82% 8.00% -5.38%
Domestic Stock Fund VEIPX 22 (373) -3.20% 8.00% -1.74%
Domestic Stock Fund VISGX 33 1,125 23.28% 10.00% 8.47%
Domestic Stock Fund VIMSX 46 41 0.74% 10.00% 0.19%
International Stock Fund VTRIX 29 2,900 50.81% 10.00% 21.02%
International Stock Fund VEIEX 9 2,078 35.01% 12.00% 46.67%
Individual Stock TRV 72 3,495 61.09% 8.00% 10.18%
Individual Stock JNJ 87 3,676 45.98% 8.00% 6.34%
Individual Stock KO 6 588 6.28% 8.00% 12.55%
Individual Stock MSFT 50 218 10.36% 10.00% 2.49%
Individual Stock IBM 100 5,362 81.53% 10.00% 9.78%
Total 42.6 $ 21,229 21.97% 6.19%
Months owned is expressed in years by dividing by 12.
The current annual growth rate for the portfolio.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

The Logical Test

Follow-along file: Continue with Excel Objective 3.00. (Use file Excel Objective 3.02 if starting here.)

A key component for the logical functions that will be demonstrated in this section is the logical test. A logical test is used in logical functions to evaluate the contents of a cell location. The results of the logical test can be either true or false. For example, the logical test *C7 = 25* (read as "if the value in cell C7 is equal to 25") can be either true or false depending on the value that is entered into cell C7. A logical test can be constructed with a variety of comparison operators, as shown in Table 3.6 "Comparison Operator Symbols and Definitions". These comparison operators will be used in the logical test arguments for the logical functions demonstrated in this chapter.

Table 3.6 Comparison Operator Symbols and Definitions

Symbol	Definition	Symbol	Definition
=	Equal To	< >	Not Equal To
>	Greater Than	> =	Greater Than or Equal To
<	Less Than	< =	Less Than or Equal To

A logical test will be used to evaluate the contents of a cell location in the **Investment Detail** worksheet. We will first demonstrate how the logical test is used to evaluate the contents of a cell location. Then we will use this logical test in the IF function, which will be demonstrated next. The following steps explain how the logical test is constructed:

1. Click cell R4 on the **Investment Detail** worksheet.
2. Type an equal sign (**=**).
3. Click cell Q4. Select the range Q4:Q18.
4. Type the greater than sign (**>**) followed by an equal sign (**=**).
5. Type the number **12**. This completes the logical test, which is shown in Figure 3.10 "Logical Test Entered into the Investment Detail Worksheet". The logical test would be stated as: "Are any of the values in the range Q4:Q18 are greater than or equal to 12?"
6. Press the ENTER key on your keyboard. Notice that the outputs of the logical test are either the word *TRUE or FALSE*. Verify this is true by checking to see that each cell greater than 12 is TRUE.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.10 Output of the logical test

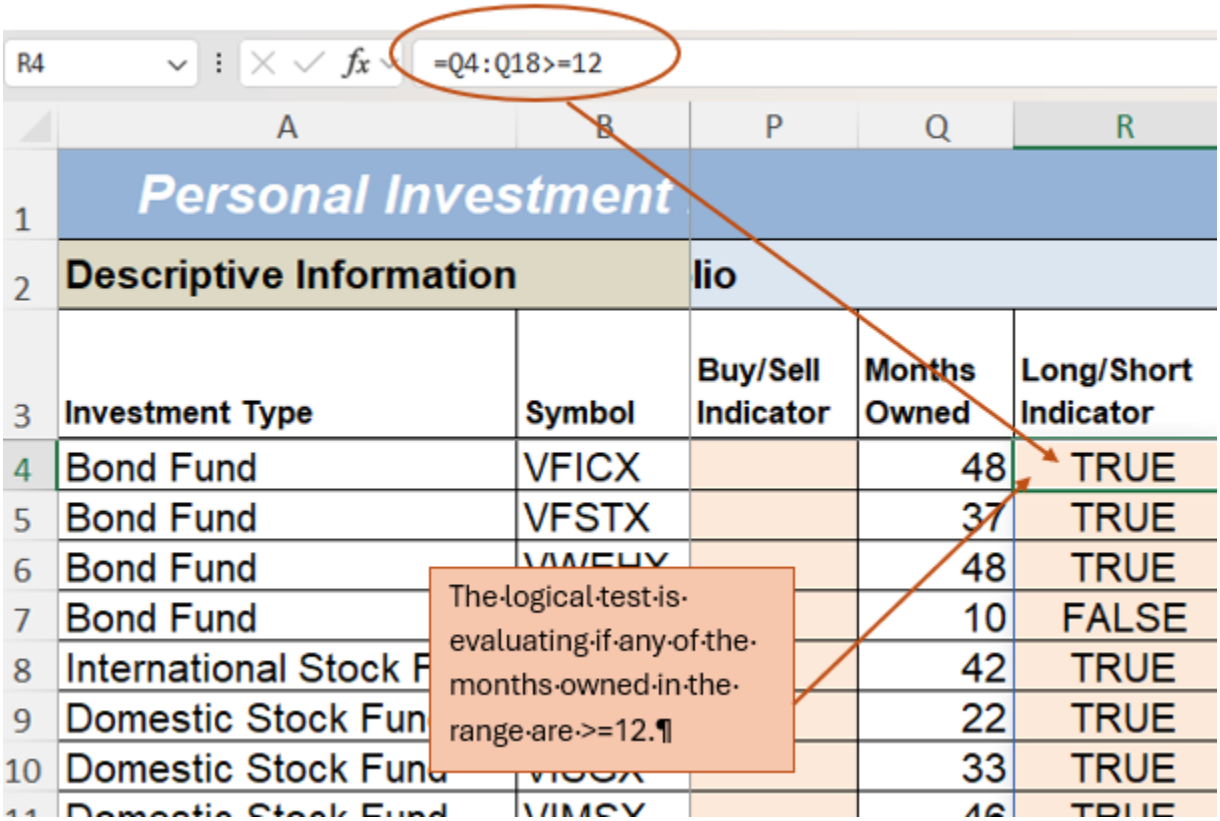


Figure 3.10 "Output of the Logical Test" shows the results of the logical test. Notice that for any values that are less than 12 in the range Q4:Q18, the logical test produces an output of FALSE.

IF Function

Follow-along file: Continue with Excel Objective 3.00. (Use file Excel Objective 3.03 if starting here.)

The IF function is used to produce a custom output based on the results of a logical test. If the results of the logical test are TRUE, the IF function will display a specific number or text or perform a calculation. If the results of the logical test are FALSE, the IF function will display a different number or text or perform a different calculation.

=IF(Logical_Test, Value_if_true, Value_if_false)

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

The arguments of the IF function are defined in Table 3.7 "Arguments for the IF Function".
Table 3.7 "Arguments for the IF Function

Argument	Definition
Logical_test	The results of the test must yield either a true or false result. For example, the test *C7>25* would be read as *if C7 is greater than 25*. If the number 30 is entered into cell C7, the logical test is true. If 20 is entered into the C7 the result would be false. If you are evaluating a cell that contains text data, the text in the logical test must be placed inside quotation marks. For example, if you wanted to test if the word *Long* is in cell C7, the logical test would be C7 = "Long".
[Value_if_true]	The output that will be displayed by the function or the calculation that will be performed by the function if the results of the logical test are true. This argument can be defined with a formula, function, number, or text. However, when defining this argument with a text output such as the word *Long*, it must be placed inside quotation marks ("*Long*").
[Value_if_false]	The output that will be displayed by the function or the calculation that will be performed by the function if the results of the logical test are false. This argument can be defined with a formula, function, number, or text. However, when defining this argument with a text output such as the word *Long*, it must be placed inside quotation marks ("*Long*").

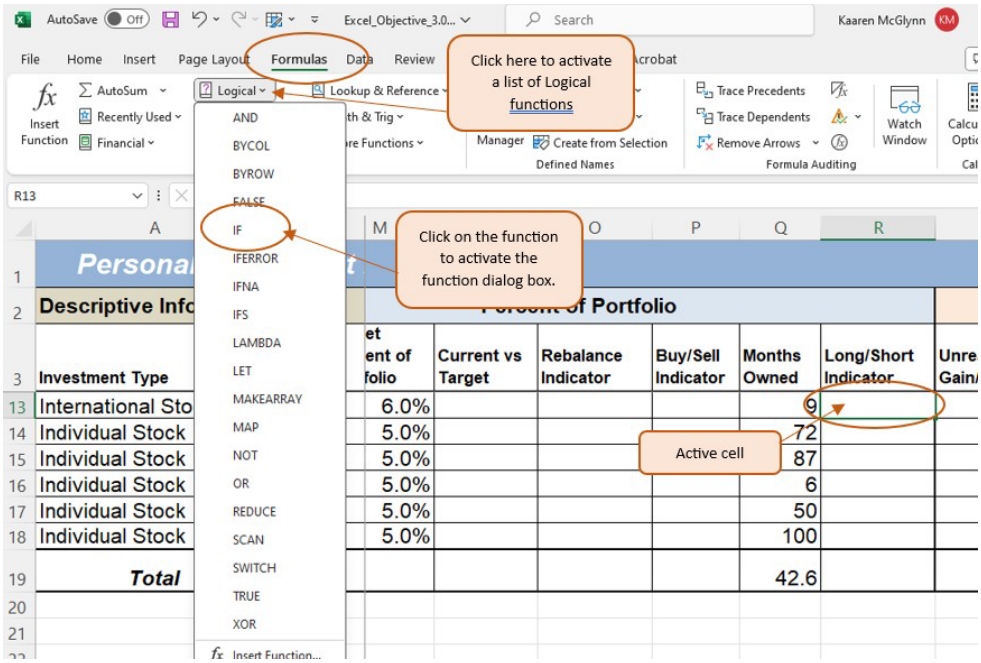
The IF function will be used in the Percent of Portfolio section of the Investment Detail worksheet. We will use the logical test that was previously demonstrated within the IF function to determine if an investment has been held for a short or long period of time. For tax purposes, an investment is considered short-term if it is held less than twelve months. This requires the investor to pay a higher tax percentage for any profit earned on the investment. An investment held twelve months or longer is considered a long- term investment. The following explains how the IF function is used to identify which investments are long term or short term:

1. Highlight the range R4:R18 on the Investment Detail worksheet and press the DELETE key on your keyboard. This will remove the logical test and allow us to replace it with an IF function.
2. Click cell R4 on the **Investment Detail** worksheet.
3. Click the Formulas tab on the Ribbon.
4. Click the Logical button in the Function Library group of commands.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

5. Click the IF function from the list of functions (see Figure 3.12 "Selecting the IF Function from the Function Library"). This opens the Function Arguments dialog box.

Figure 3.12 Selecting the IF Function from the Function Library

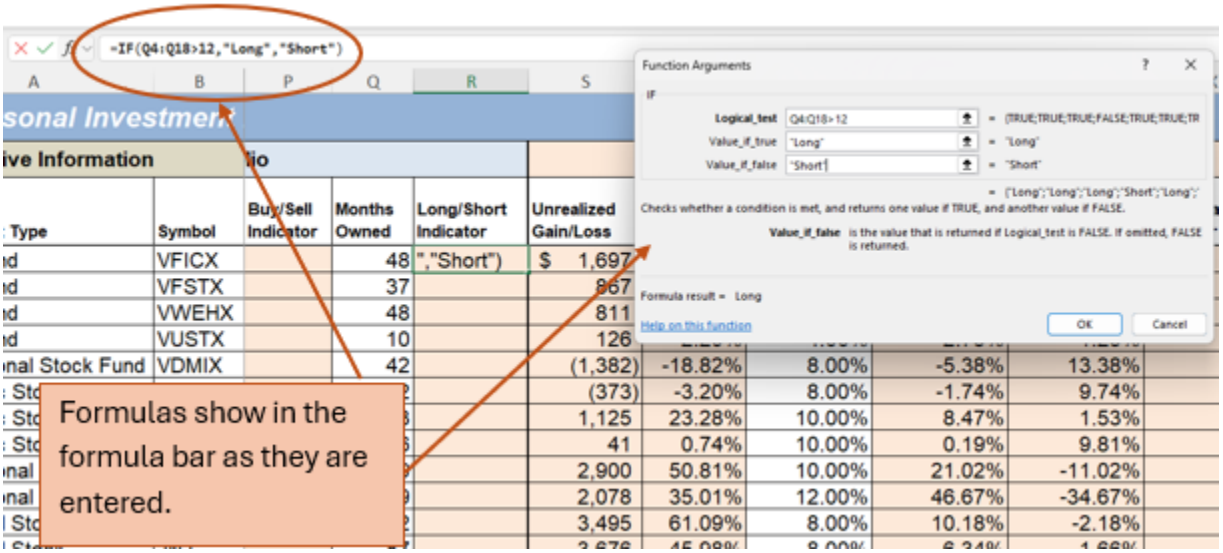


6. Click in the **Logical_test** argument (see Figure 3.13 "Logical_Test Argument Defined").
7. From the Use in Formula select the range Months_Owned.
8. Type the greater than sign (**>**) followed by an equal sign(**=**).
9. Type the number **12**.

Figure 3.13 "Logical_Test Argument Defined" shows the appearance of the IF Function Arguments dialog box after defining the **Logical_test** argument. Notice that next to the **Logical_test** input box, Excel shows that the results of the test are true. This makes sense given that the value in cell Q4 is 48, which is greater than 12.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.13 Logical_Test Argument Defined


=IF(Q4:Q18>12,"Long","Short")
Function Arguments
Logical_test Q4:Q18>12
Value_if_true "Long"
Value_if_false "Short"
Checks whether a condition is met, and returns one value if TRUE, and another value if FALSE.
Value_if_false is the value that is returned if Logical_test is FALSE. If omitted, FALSE is returned.
Formula result = Long
Help on this function
OK
Cancel
Formulas show in the formula bar as they are entered.

10. Press the TAB key on your keyboard to advance to the next argument, which is **Value_if_true**.
11. Type the word **Long** in quotation marks. If you forget to put words or text in quotation marks using the Function Arguments dialog box, Excel will insert the quotation marks for you.
12. Press the TAB key on your keyboard to advance to the next argument, which is **Value_if_false**.
13. Type the word **Short** in quotation marks.
14. Click the OK button on the Function Arguments dialog box to complete the function.
15. Copy the IF function in cell R4 and paste it into the range R5:R18.

Integrity Check - Placing Text in Quotation Marks for Logical Functions
If you are using a logical function to evaluate text data in a cell location, or if you are using a logical function to output text data, the text must be placed inside quotation marks. For example, if you are using a logical function to evaluate whether the word *Long* is entered into cell B5, the logical test must appear as follows: *B5= "Long"*. If you omit the quotation marks, the function may produce an erroneous false result for the test.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.14 "Completed Function Arguments Dialog Box for the IF Function "shows the completed Function Arguments dialog box for the IF function. Notice that the results of the function are displayed in the dialog box. Since the value in cell Q4 is greater than 12, the word *Long* will be displayed in cell R4.

Figure 3.14 Completed Function Arguments Dialog Box for the IF Function

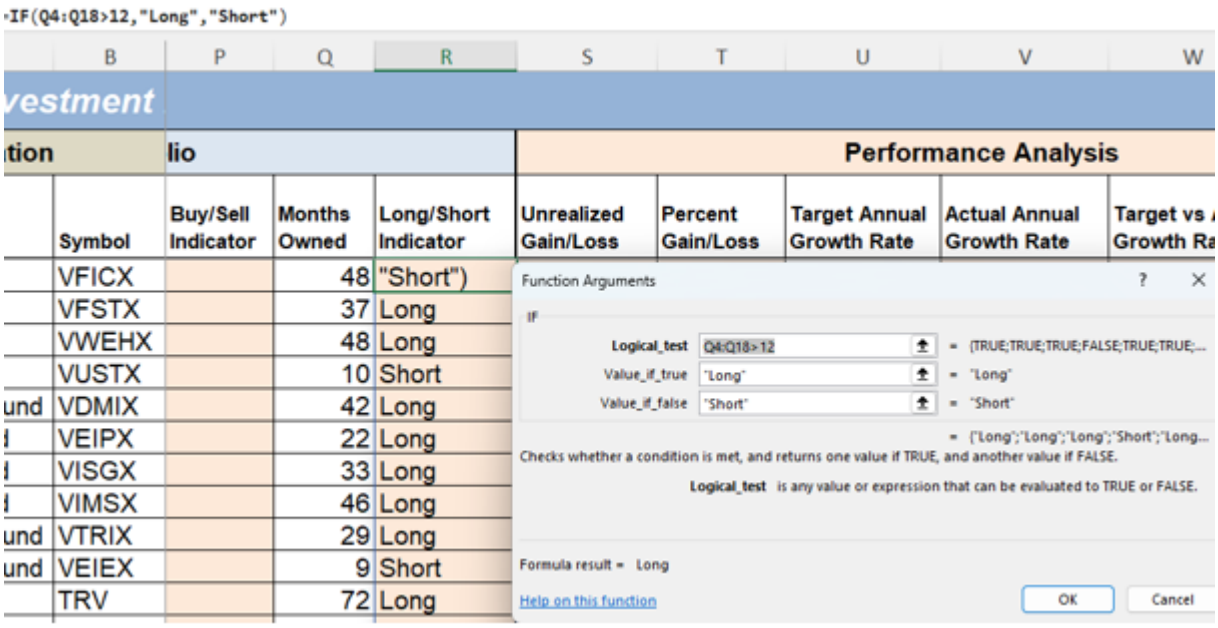


Figure 3.14 also shows the completed Long/Short Indicator column on the **Investment Detail** worksheet. Notice the word *Short* is displayed for any investment held less than twelve months.

Assumption Tables

Assumption tables are set up and used in Excel worksheets to avoid entering actual numbers into a function. Instead, they provide a convenient area to enter the variables in your data that might change. For instance, payments on a mortgage could be 12 (monthly), 26 (every two weeks), 4 (quarterly), or 2 (semi-annually). By providing a cell to link to in your functions, you only need to change that one cell to change the results of your formulas.

We will set up assumption tables in our Excel file. The fields in the file will be named so that the function arguments are easy to understand. Remember that naming a cell will make it an absolute cell reference. It is the equivalent of $A$1 where both the row and column reference are anchored.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Dynamic Array Issues with Nesting Logical Functions in IF Functions:

In the last section we were able to use a dynamic array in a simple IF function to determine if the assets had been held for a long or short period. However, when we move into nesting functions within an IF function, we are no longer able to use dynamic arrays. We will revert to some legacy techniques to accomplish our nested logical functions: namely using named cells and ranges. Once a function has been created it will then need to be copied down the column.

The OR Function

Follow-along file: Continue with Excel Objective 3.00. (Use file Excel Objective 3.04 if starting here.)

The OR function is a logical test to evaluate the contents of a cell location. The OR function allows you to define several logical tests as opposed to just one. Like any logical test in Excel, the return from the test will always be TRUE or FALSE.

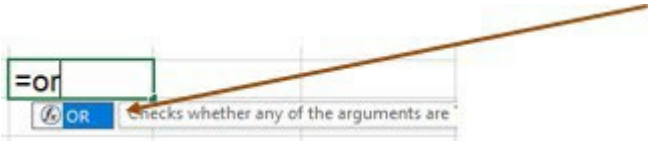
If *any* of the logical tests are true, the output of the function will be the word *TRUE*. If *all* the logical tests are false, the output of the function will be the word *FALSE*. This differs from the IF function because the output of the function is only the word *TRUE* or the word *FALSE*. As a result, the OR function is commonly used within the IF function to enable specific outputs to be defined.

The purpose of the Performance Indicator column is to identify any investment where either the Unrealized Gain/Loss is less than zero *or* the Target vs. Actual Growth Rate is less than –1%. We will use the function in the logical test of an IF function so we can define a specific output based on the results of the OR function. We will set up the assumption table and then demonstrate how the OR function works by itself, which is outlined in the following steps:

1. Click cell A21 in the Investment Detail worksheet.
2. Type Assumption Table and press Enter.
3. In cell A22 type UnrealizedGainLoss < (no spaces)
4. In cell B22 type 0. Name cell B22 by selecting A22:B22, Go to Create from Selection on the Formula ribbon, make sure Left Column is selected for the name, then hit the return.
5. In cell A23 type Target vs Actual Growth <
6. In cell B23 type (-1%) (minus 1 percent). Name B23 in the same way as step 4.
7. Highlight cells S3:S18, hold the control key and select the range W4:W18. Go to Create from Selection on the Formula ribbon, make sure Top Row is selected for the name, then hit the return.
8. Click cell X4 and type an equal sign (=).

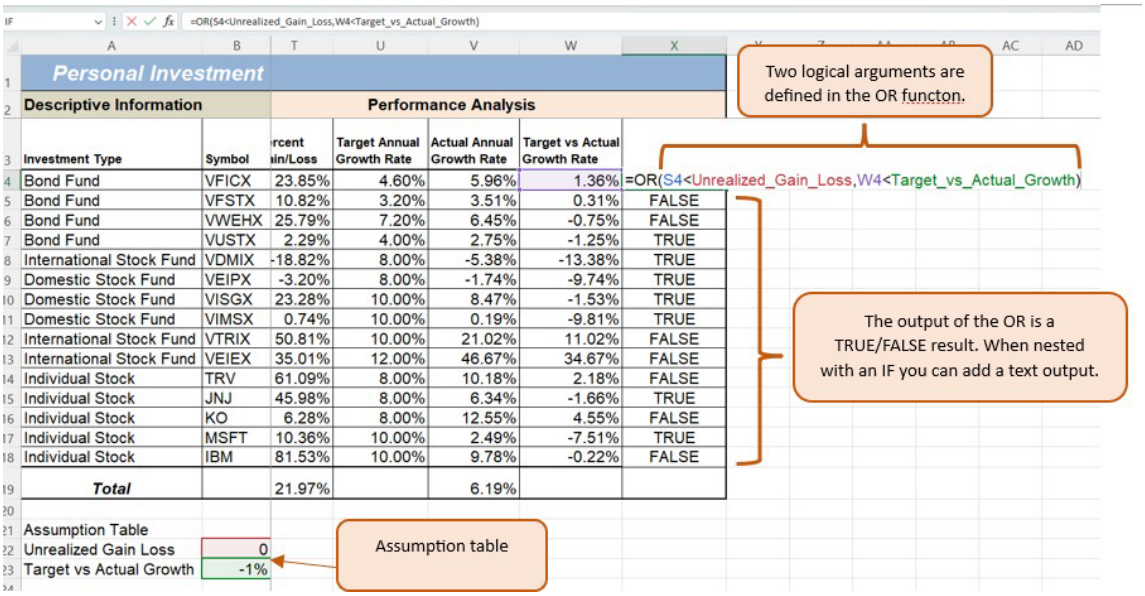
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

9. Type the function name OR and double click on the function when it appears in the function list.



10. Click on S4 on the Investment Detail worksheet. Excel will insert the named range @Unrealized_Gain_Loss.(This is the first test in or OR logical test.)
11. Type the less than symbol (<) then click on cell B22. Excel will insert the named cell. This completes the first logical test, which determines if any of the values in the range S4:S22 are less than zero.
12. Type a comma. This advances the function to a second logical test.
13. Click on cell W4 on the Investment Detail worksheet. (This is the second range we are testing in our logical test.)
14. Type the less than symbol (<) then click on cell B23. This completes the second logical test, which is evaluating if the value in cell W4 is less than –1%.
15. Type a closing parenthesis ()) and press the ENTER key on your keyboard.
16. Copy the OR function in cell X4 and paste it into the range X5:X18 using the Paste Formulas command.

Figure 3.16 Completed OR Function


=OR(S4<Unrealized_Gain_Loss,W4<Target_vs_Actual_Growth)
Two logical arguments are defined in the OR functon.
The output of the OR is a TRUE/FALSE result. When nested with an IF you can add a text output.
Assumption table

Personal Investment							
Descriptive Information			Performance Analysis				
Investment Type	Symbol	rcent in/Loss	Target Annual Growth Rate	Actual Annual Growth Rate	Target vs Actual Growth Rate	=OR(S4<Unrealized_Gain_Loss,W4<Target_vs_Actual_Growth)	
Bond Fund	VFICX	23.85%	4.60%	5.96%	1.36%		
Bond Fund	VFSTX	10.82%	3.20%	3.51%	0.31%	FALSE	
Bond Fund	VWEHX	25.79%	7.20%	6.45%	-0.75%	FALSE	
Bond Fund	VUSTX	2.29%	4.00%	2.75%	-1.25%	TRUE	
International Stock Fund	VDMIX	-18.82%	8.00%	-5.38%	-13.38%	TRUE	
Domestic Stock Fund	VEIPX	-3.20%	8.00%	-1.74%	-9.74%	TRUE	
Domestic Stock Fund	VISGX	23.28%	10.00%	8.47%	-1.53%	TRUE	
Domestic Stock Fund	VIMSX	0.74%	10.00%	0.19%	-9.81%	TRUE	
International Stock Fund	VTRIX	50.81%	10.00%	21.02%	11.02%	FALSE	
International Stock Fund	VEIEX	35.01%	12.00%	46.67%	34.67%	FALSE	
Individual Stock	TRV	61.09%	8.00%	10.18%	2.18%	FALSE	
Individual Stock	JNJ	45.98%	8.00%	6.34%	-1.66%	TRUE	
Individual Stock	KO	6.28%	8.00%	12.55%	4.55%	FALSE	
Individual Stock	MSFT	10.36%	10.00%	2.49%	-7.51%	TRUE	
Individual Stock	IBM	81.53%	10.00%	9.78%	-0.22%	FALSE	
Total		21.97%		6.19%			

Assumption Table	
Unrealized Gain Loss	0
Target vs Actual Growth	-1%

Figure 3.16 "Completed OR Function by Itself" shows the construction and result of the OR function by itself. Notice that the only output of the function is the word *TRUE* or the word *FALSE*. If either the Unrealized Gain/Loss is less than zero or the Target vs. Actual Growth Rate is less than –1%, the function shows the word *TRUE*. However, these descriptions will

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

not be helpful for the person using this worksheet. Displaying the words *OK* or *Warning* would be far more helpful in identifying investments that need to be evaluated. The only way we can return a text response to the result of the OR function is to nest it in an IF function. We can do this if we use the OR function as the logical test argument of the IF function.

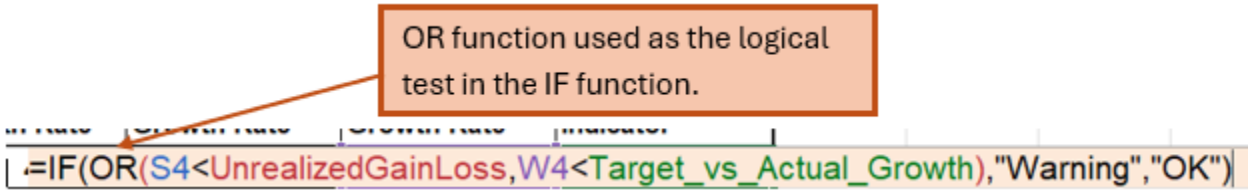
The following steps explain how to accomplish this:

1. Highlight the range X4:X18 on the **Investment Detail** worksheet and press the DELETE key on your keyboard. We are going to start over by creating an IF function.
2. Click cell X4 on the **Investment Detail** worksheet.
3. Type an equal sign (**=**).
4. Type the function name **IF** followed by an open parenthesis(**(**).
5. Type the function name **OR** followed by an open parenthesis (**(**). The OR function is being placed into the **logical_test** argument of this IF function.
6. Click cell S4 on the **Investment Detail** worksheet.
7. Type the less than symbol (**<**) click cell B22.
8. Type a comma. This advances the function to a second logical test.
9. Click cell W4 on the **Investment Detail** worksheet.
10. Type the less than symbol (**<**) then click cell B23.
11. Type a closing parenthesis **)**.
12. Type a comma. This completes the **logical_test** argument of the IF function. We can now go on to define the **value_if_true** and the **value_if_false** arguments. This will allow us to specify what the output of the function should be instead, using the OR function outputs of either TRUE or FALSE.
13. Type the word **Warning**. Be sure to enclose the word in quotation marks.
14. Type a comma. This will advance the function to the **value_if_false** argument.
15. Type the word **OK**. Be sure to enclose the word in quotation marks.
16. Type a closing parenthesis (**)**) and press the ENTER key on your keyboard.
17. Copy the IF function in cell X4 and paste it into the range X5:X18 using the Paste Formulas command.

Figure 3.17 "OR Function in the Logical Test of the IF Function" shows the OR function within the **logical_test** argument of the IF function. The logical test of the IF function is now evaluating if the results of the OR function are true.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.17 OR Function in the Logical Test of the IF Function


OR function used as the logical test in the IF function.
=IF(OR(S4<UnrealizedGainLoss,W4<Target_vs_Actual_Growth),"Warning","OK")

Skill Refresher – OR Function

1. Type an equal sign (=).
2. Type the function name **OR** followed by an open parenthesis (.
3. Define the **logical_test** argument to evaluate the contents of a cell location such that the result of the test is either true or false.
4. Define additional logical test arguments as needed. The output of the function will be TRUE if any of the logical tests are true.
5. Type a closing parenthesis).
6. Press the ENTER key on your keyboard.

The AND Function

Follow-along file: Continue with Excel Objective 3.00. (Use file Excel Objective 3.05 if starting here.)

The portfolio manager wants to create a function that will help him make decisions about buying, holding, or selling different investments in the portfolio. The criteria around the decision will be:

- Buy when the fund's Current vs Target percent of portfolio value is less than1% AND the fund's Unrealized Gain/Loss is greater than 0.
- Otherwise sell or hold the fund in the portfolio.

He will do that by using the AND as the logical test to decide to buy, sell or hold the fund. The AND function is almost identical to the OR function in that it is composed of only logical tests and produces one of two possible outputs: TRUE or FALSE. However, all logical tests defined for the AND function must be true to produce a TRUE output. If one logical test is false, the function will produce a FALSE output. We will use the AND function to complete the Buy/Sell Indicator column on the Investment Detail worksheet. This column will show either the word Buy or the words Hold or Sell based on the results of the logical test argument of an IF function. We will expand our assumption table to

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

incorporate these new parameters and then use the AND function to define the logical test argument of the IF function.

The following steps explain how to accomplish this:

1. In cell A25 Type: Hold/Sell Criteria:
2. In cell A26 type Buy Current vs Target<
3. In cell B26 enter (-1%)
4. In cell A27 type Long Term >
5. In cell B27 enter (12)
6. In cell A28 enter Sell Target vs Growth >
7. In cell B28 enter 1%
8. In cell A29 enter Unrealized Gain >=
9. In cell B29 enter (0).

Assumption Table	
Unrealized Gain Loss	0
Target vs Actual Growth	-1%
Hold/Sell Criteria	
Buy Current vs. Target <	-1%
Sell Target vs. Growth >=	1%
Unrealized Gain/Loss >=	0

Modified assumption table with the criteria for buying/selling.

10. We need to name the new cells. Name the new assumption cells by highlighting A26:B29 and on the Formula ribbon, Create from selection. Make sure left column is checked and click OK.
11. Click cell P4 on the **Investment Detail** worksheet.
12. Type an equal sign (=).
13. Type the function name **IF** followed by an open parenthesis(**(**).

The logical test we will use is the criteria given above. We will test to see if the Current vs Target percent of portfolio value is less than 1% AND the fund's Unrealized Gain/Loss is greater than 0.

14. Type the function name **AND** followed by an open parenthesis (**(**). The AND function is being placed into the **logical_test** argument of this IF function.
15. Click cell N4(the fund's current vs. target value) and then type the less than symbol (**<**).
16. Click cell B26. Buy Current_vs_Target named cell will appear.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

17. Type a comma. This advances the AND function to the second argument in the AND function.
18. TypeS4. (Unrealized gain/loss) (Your function maybe overlapping S4 and you may not be able to click on it.)
19. Type a greater than symbol (**>**) followed by an equal sign (**=**). These symbols are used to evaluate if the value in a cell location is greater than or equal to a target value.
20. Click on cell B22. This will place your named cell Unrealized Gain into the AND.
21. Close the AND function by closing parenthesis (**)**)
22. Type a comma. This advances the IF function to the **value_if_true** argument.
23. Type the word **Buy** enclosed in quotation marks as shown in Figure 3.19 "Results of the AND Function in the Logical Test Argument of an IF Function". If the Current vs. Target value is less than −1% and the Unrealized Gain/Loss is greater than or equal to zero, the function will show the word *Buy*. In other words, if the investment is less than the desired percentage for the total portfolio *and* it is currently not losing money, we will buy more of that investment, so it is in line with the target percentage of the portfolio.
24. Type a comma.
25. Type the words "**Hold or Sell"** enclosed in quotation marks. For all other investments that are not designated with a *Buy* indicator, the function will show the words *Hold or Sell*. This indicates that an investment could either be held or sold.
26. Type the closing parenthesis **)**. Then press the ENTER key on your keyboard. You should see the result "Buy" in cell P4.
27. Copy the IF function in cell P4 and paste it into the range P5:P18 using the Paste Formulas command or the Auto fill.
28. Increase the width of Column P to 12 points.

Figure 3.18 "AND Function Placed in the Logical Test of an IF Function" shows the appearance of the AND functions that has been added to the logical test of the IF functions.

Figure 3.18 AND Function Placed in the Logical Test of an IF Function

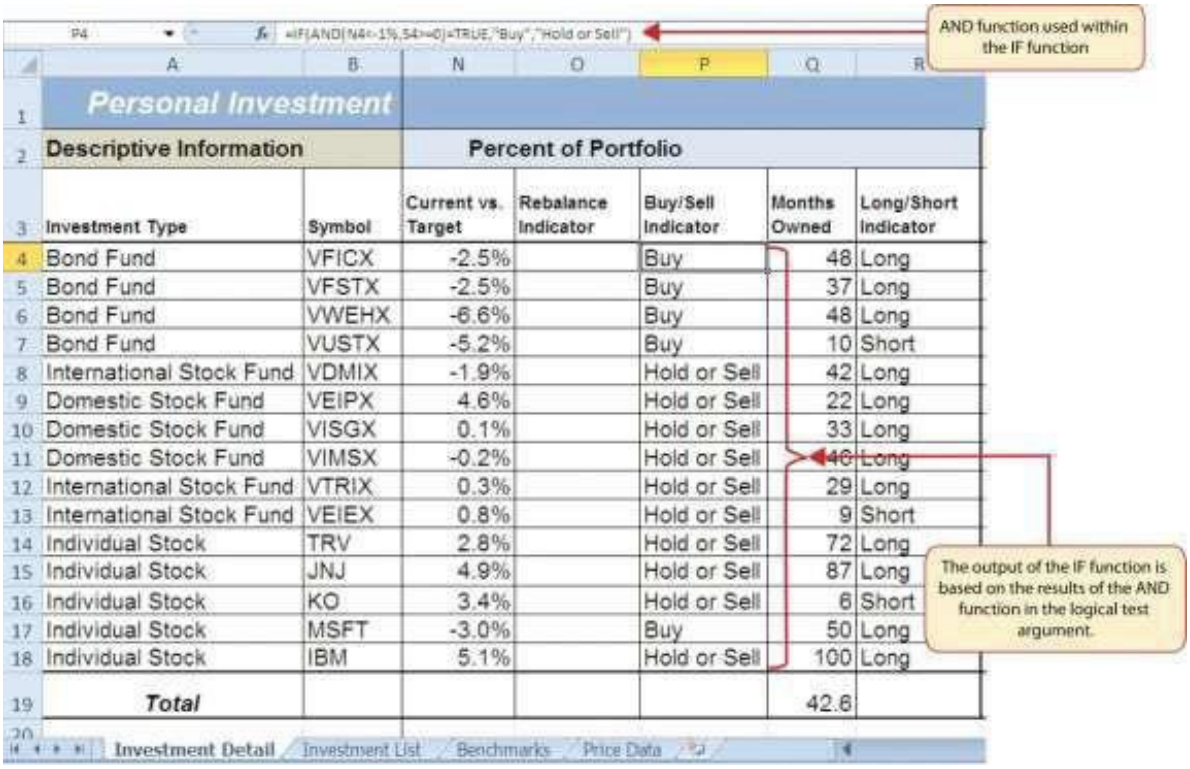
Buy/Sell Indicator	Months Owned	Long/Short Indicator	Unrealized Gain/Loss	Percent Gain/Loss	Target Annual Growth Rate	Actual Annu Growth Rat

=IF(AND(N4<Buy_Current_Vs_Target,S4>Unrealized_Gain),"Buy","Hold or Sell")

Figure 3.19 "Results of the AND Function in the Logical Test Argument of an IF Function" shows the results of the completed AND function within an IF function after it is copied and pasted into the range P5:P18.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.19 Results of the AND Function in the Logical Test Argument of an IF Function


AND function used within the IF function
The output of the IF function is based on the results of the AND function in the logical test argument.

	A	B	N	O	P	Q	R
1	Personal Investment						
2	Descriptive Information		Percent of Portfolio				
3	Investment Type	Symbol	Current vs. Target	Rebalance Indicator	Buy/Sell Indicator	Months Owned	Long/Short Indicator
4	Bond Fund	VFICX	-2.5%		Buy	48	Long
5	Bond Fund	VFSTX	-2.5%		Buy	37	Long
6	Bond Fund	VWEHX	-6.6%		Buy	48	Long
7	Bond Fund	VUSTX	-5.2%		Buy	10	Short
8	International Stock Fund	VDMIX	-1.9%		Hold or Sell	42	Long
9	Domestic Stock Fund	VEIPX	4.6%		Hold or Sell	22	Long
10	Domestic Stock Fund	VISGX	0.1%		Hold or Sell	33	Long
11	Domestic Stock Fund	VIMSX	-0.2%		Hold or Sell	46	Long
12	International Stock Fund	VTRIX	0.3%		Hold or Sell	29	Long
13	International Stock Fund	VEIEX	0.8%		Hold or Sell	9	Short
14	Individual Stock	TRV	2.8%		Hold or Sell	72	Long
15	Individual Stock	JNJ	4.9%		Hold or Sell	87	Long
16	Individual Stock	KO	3.4%		Hold or Sell	6	Short
17	Individual Stock	MSFT	-3.0%		Buy	50	Long
18	Individual Stock	IBM	5.1%		Hold or Sell	100	Long
19	*Total*					42.6	

Investment Detail | Investment List | Benchmarks | Price Data

Skill Refresher – AND Function

1. Type an equal sign (=).
2. Type the function name **AND** followed by an open parenthesis (**(**).
3. Define the **logical_test** argument to evaluate the contents of a cell location such that the result of the test is either true or false.
4. Define additional logical test arguments as needed. The output of the function will be TRUE if ALL of the logical tests are true.
5. Type a closing parenthesis **)**.
6. Press the ENTER key on your keyboard.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Simple Nested IF Functions

Follow-along file: Continue with Excel Objective 3.00. (Use file Excel Objective 3.06 if starting here.)

When constructing the IF function, the logical test can produce only two potential outcomes when evaluating the data in a cell. In addition, the function can produce only two possible outputs, which are defined in the **value_if_true** and **value_if_false** arguments. However, there may be situations when you need to test for several possible outcomes, which may require more than two possible outputs. To accomplish this, you need to create a nested IF function. A nested IF function is when either the **value_if_true** or **value_if_false** arguments are defined with another IF function.

For the Personal Investment workbook, a nested IF function is required to complete the Rebalance Indicator column (Column O) on the **Investment Detail** worksheet (see Figure 3.19 "Results of the AND Function in the Logical Test Argument of an IF Function"). The purpose of this column is to indicate where the portfolio needs to be rebalanced.

Looking at the Current vs. Target column (Column N) you can see that several investments have a significant negative number where the investment value has fallen below the target percentage for the portfolio. Other investments have a significant positive number where the investment has exceeded the target percentage for the portfolio. For this portfolio, a number greater than 1% or less than –1% will be considered significant. Therefore, we will need to assess three possible outcomes when creating a logical test that evaluates the values in Column N. Those are:

- The first test will be if the Current vs. Target value is greater than 1% we will Rebalance the portfolio.
- The second test will be if the Current vs. Target value is less than –1% we will Rebalance the portfolio.
- The third test will be if both the first test and the second test are false, we are OK with the portfolio.

Because this problem involves three tests, we need to construct a nested IF function to produce the outputs in the Rebalance Indicator column. The first thing we will do is add to our assumption table.

1. In cell A31 type Rebalance Portfolio
2. In cell A32 type Low Current vs. Target
3. In cell B32 type -1% (It is important to use the percent symbol (**%**) after the number 1. If you omit the percent symbol, Excel will test if the value in cell N4 is greater than 100%.)
4. In cell B33 type High Current vs. Target

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

5. In cell C33 type 1%
6. Name the new assumptions by highlighting cells A32:B33 and Create from selection on the Formula ribbon. Make sure Left Column only is checked.

Now that the assumption table has been created, we can use the following steps to create the Nested IF:

1. Click cell O4 on the **Investment Detail** worksheet.
2. Type an equal sign (=).
3. Type the function name **IF** followed by an open parenthesis(().

Now the logical test:

4. Click cell N4.
5. Type the greater than symbol (>) then click on cell B33 or find the named cell (High_Current_vs_Target), in the Use in Formula drop-down from the Formulas ribbon.
6. Type a comma.

Now the Value_if_true:

7. Type the word **Rebalance** inside quotation marks. When using text data to define any of the arguments for the IF function, the text must be placed inside quotation marks.
8. Type a comma.

The Value_if_false argument will be another IF function.

9. Start another IF function by typing the function name **IF** followed by an open parenthesis (().

Second IF function's logical test.

10. Click cell N4.
11. Type the less than symbol (<) then click on cell B32 or find the named cell (Low_Current_vs_Target), in the Use in Formula drop-down from the Formulas ribbon.
12. Type a comma.

Second IF's Value_if_true argument.

13. Type the word **Rebalance** inside quotation marks.
14. Type a comma.

Second IF's Value_if_false argument.

15. Type the word **OK** inside quotation marks.
16. Type two closing parentheses ())). Since two IF functions were started, there are two open parentheses in the function. As a result, we need to add two closing

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

parentheses; otherwise, Excel will produce an error message stating that a closing parenthesis is missing. Excel color codes the parenthesis so you know which function you are closing with each colored parenthesis.

17. Press the ENTER key on your keyboard.
18. Copy the nested IF function in cell O4 and paste it into the range O5:O18 using the Paste Formulas command.

Integrity Check - Using Logical Functions to Evaluate Percentages

If you are using a logical function to evaluate percentages in a cell location, be sure to use the percent symbol when defining the logical test. For example, if you are testing cell location B5 to determine if the value is greater than 10%, the logical test should appear as follows: *B5>10%*. If you omit the percent sign, the logical test will evaluate cell B5 to see if the value is greater than 1000%. This may erroneously force the function to produce the *value_if_false* output. You can also convert the percentage to a decimal in the logical test. For example, in decimal form, the logical test can be constructed as follows: *B5>.10*.

Figure 3.20 "Completed Nested IF Function" shows how the completed nested IF function should appear in cell O4 of the **Investment Detail** worksheet. In addition, we see the results of the function after it was pasted into the range O5:O18. Notice that for any investment where the Current vs. Target value is between plus or minus 1%, the word *OK* appears.

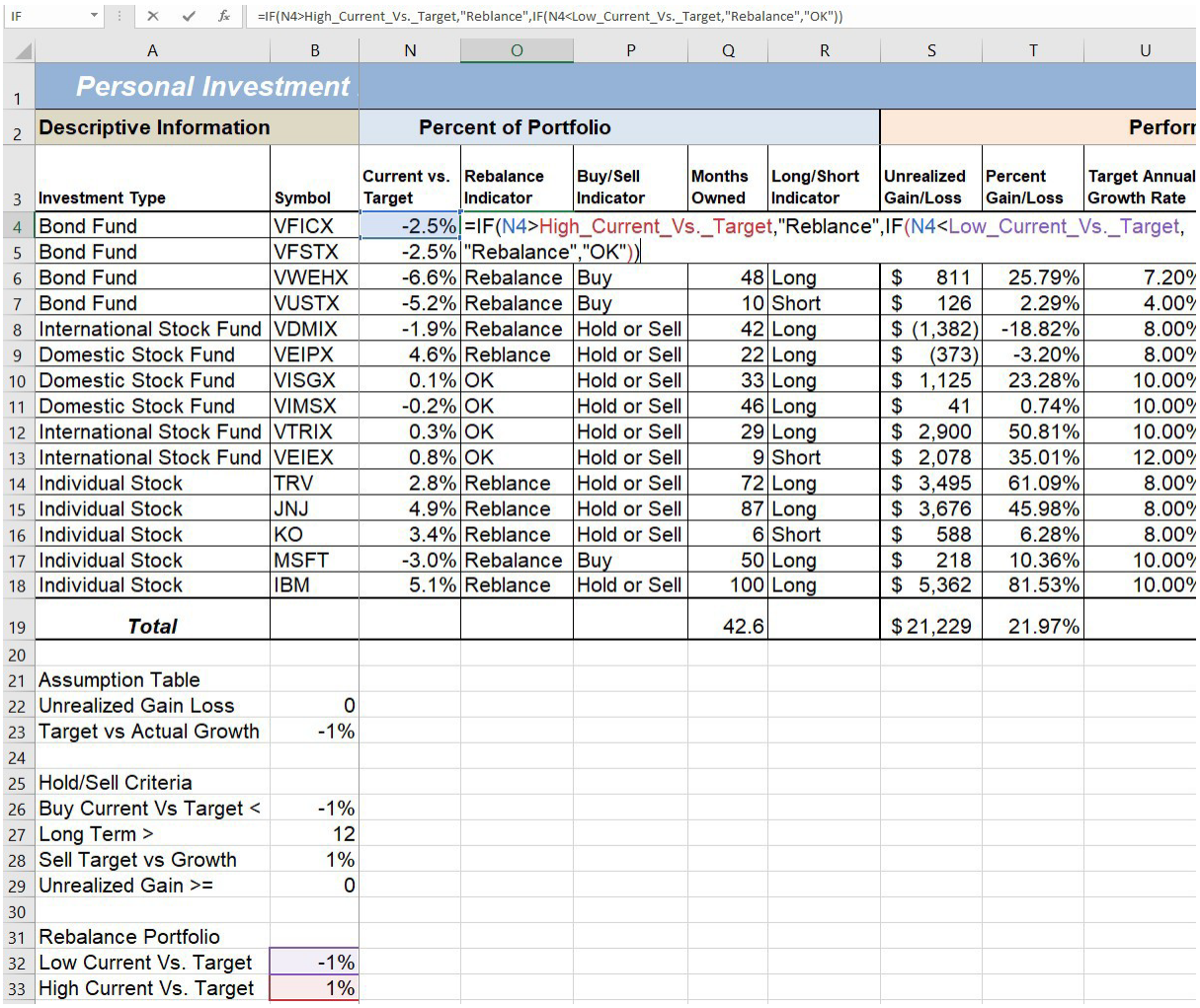
Integrity Check - More than one way to set up a problem

This problem could also have been solved by using an IF(OR). When using functions, the easier you can make the nested functions, the easier it is to find your errors in the functions. To use an IF(OR) for this you would:

=IF(OR(N4<-1%,N4>1%),"Rebalance","OK")

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.20 Completed Nested IF Function



IF | =IF(N4>High_Current_Vs._Target,"Reblance",IF(N4<Low_Current_Vs._Target,"Rebalance","OK"))

	A	B	N	O	P	Q	R	S	T	U
1	Personal Investment									
2	Descriptive Information		Percent of Portfolio							Perforr
3	Investment Type	Symbol	Current vs. Target	Rebalance Indicator	Buy/Sell Indicator	Months Owned	Long/Short Indicator	Unrealized Gain/Loss	Percent Gain/Loss	Target Annual Growth Rate
4	Bond Fund	VFICX	-2.5%	=IF(N4>High_Current_Vs._Target,"Reblance",IF(N4<Low_Current_Vs._Target,						
5	Bond Fund	VFSTX	-2.5%	"Rebalance","OK"))						
6	Bond Fund	VWEHX	-6.6%	Rebalance	Buy	48	Long	$ 811	25.79%	7.20%
7	Bond Fund	VUSTX	-5.2%	Rebalance	Buy	10	Short	$ 126	2.29%	4.00%
8	International Stock Fund	VDMIX	-1.9%	Rebalance	Hold or Sell	42	Long	$ (1,382)	-18.82%	8.00%
9	Domestic Stock Fund	VEIPX	4.6%	Reblance	Hold or Sell	22	Long	$ (373)	-3.20%	8.00%
10	Domestic Stock Fund	VISGX	0.1%	OK	Hold or Sell	33	Long	$ 1,125	23.28%	10.00%
11	Domestic Stock Fund	VIMSX	-0.2%	OK	Hold or Sell	46	Long	$ 41	0.74%	10.00%
12	International Stock Fund	VTRIX	0.3%	OK	Hold or Sell	29	Long	$ 2,900	50.81%	10.00%
13	International Stock Fund	VEIEX	0.8%	OK	Hold or Sell	9	Short	$ 2,078	35.01%	12.00%
14	Individual Stock	TRV	2.8%	Reblance	Hold or Sell	72	Long	$ 3,495	61.09%	8.00%
15	Individual Stock	JNJ	4.9%	Reblance	Hold or Sell	87	Long	$ 3,676	45.98%	8.00%
16	Individual Stock	KO	3.4%	Reblance	Hold or Sell	6	Short	$ 588	6.28%	8.00%
17	Individual Stock	MSFT	-3.0%	Rebalance	Buy	50	Long	$ 218	10.36%	10.00%
18	Individual Stock	IBM	5.1%	Reblance	Hold or Sell	100	Long	$ 5,362	81.53%	10.00%
19	***Total***					42.6		$ 21,229	21.97%	
20										
21	Assumption Table									
22	Unrealized Gain Loss	0								
23	Target vs Actual Growth	-1%								
24										
25	Hold/Sell Criteria									
26	Buy Current Vs Target <	-1%								
27	Long Term >	12								
28	Sell Target vs Growth	1%								
29	Unrealized Gain >=	0								
30										
31	Rebalance Portfolio									
32	Low Current Vs. Target	-1%								
33	High Current Vs. Target	1%								

Nested Logical Functions

Let's revisit the IF(AND) function we created earlier. We will change the IF function so that it will nest a second IF and give us a Hold or Sell decision. The additional condition we are adding to our previous function is:

- Sell when
    - the Current vs Target percent is greater than 1,
    - the Unrealized Gain/Loss is greater than or equal to zero,
    - AND the Months Owned is greater than 12.
- Otherwise Hold

Change the existing IF(AND) by:

1. Return to the Buy/Sell Indicator Column (Col P).
2. Click the F2 function key to enter the edit mode. (You can also double-click in the cell.)

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

3. Position your cursor after the "Buy", Make sure you are on the right side of the comma.

Now we will test to see if we should Hold or Sell by inserting a second IF function as the false result for our first IF function.

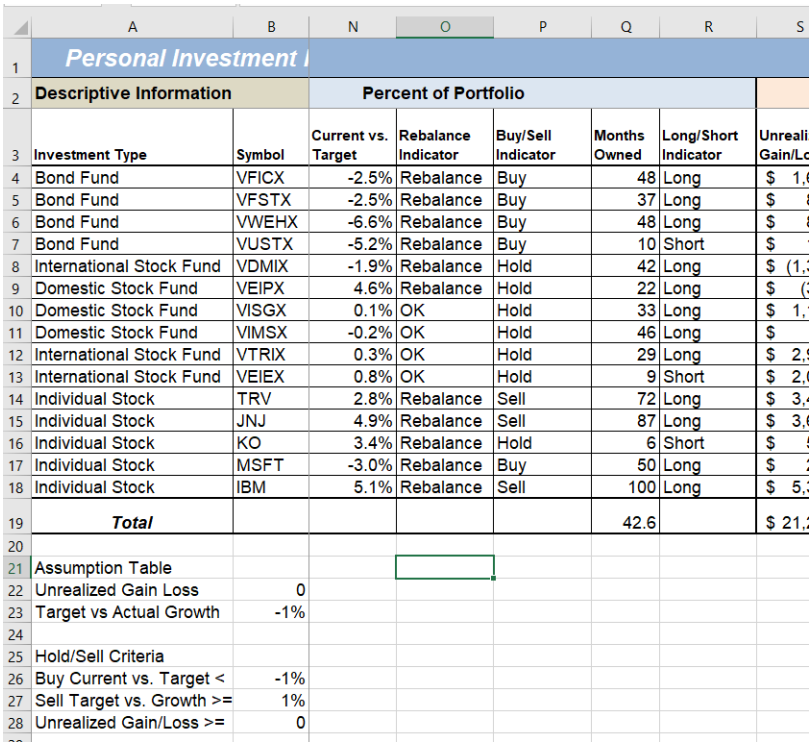
4. Type the function name **IF** followed by an open parenthesis **(**.
5. Type the function name **AND** followed by an open parenthesis **(**. The AND function is being placed into the **logical_test** argument of this IF function.
6. Click cell N4(the fund's current vs. target value) and then type the less than symbol(**<**).
7. Click cell B26. Your Current_vs_Target named cell will appear.
8. Type a comma. This advances the AND function to the second logical test.
9. Click cell S4. (Unrealized gain/loss)
10. Type a greater than equal to (**>=**). These symbols are used to evaluate if the value in a cell location is greater than or equal to a target value.
11. Click on cell B22. This will place your named cell Unrealized_Gain_Loss into the AND.
12. Type a comma.
13. Last, we will test to see if the Months Owned is greater than 12 which will put us into the long-term investment category. Click on cell R4.
14. Type a greater than (**>**)
15. Click on cell B27. Long Term will show in your formula.
16. Close the parenthesis for the AND function.
17. Type an equal sign (**=**) followed by the word **TRUE**. Do *not* enclose the word in quotation marks. Type a comma.
18. Type the word "**Sell"** enclosed in quotation marks.
19. Type a comma.
20. Type the word "**Hold" enclosed** in quotation marks. For all other investments that are not designated with a *Buy* indicator, the function will show the words *Hold or Sell*. This indicates that an investment could either be held or sold.
21. Type two closing parenthesis **)**) one to close the second IF function and the second to close the first IF function.
22. Then press the ENTER key on your keyboard.

Figure 3.20b AND Function Placed in the Logical Test of an IF Function

Buy/Sell Indicator	Months Owned	Long/Short Indicator	Unrealized Gain/Loss	Percent Gain/Loss	Target Annual Growth Rate	Actual Annual Growth Rate	Target vs Actual Growth Rate	Performance Indicator
=IF(AND(N4<Buy_Current_Vs_Target,S4>Unrealized_Gain),"Buy",IF(AND(N4<Buy_Current_Vs_Target, S4>=UnrealizedGainLoss,Q4>Long_Term),"Sell","Hold"))								

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.20c Nested IFs and ANDs Functions completed for the Rebalance



	A	B	N	O	P	Q	R	S
1	Personal Investment I							
2	Descriptive Information		Percent of Portfolio					
3	Investment Type	Symbol	Current vs. Target	Rebalance Indicator	Buy/Sell Indicator	Months Owned	Long/Short Indicator	Unreali Gain/Lo
4	Bond Fund	VFICX	-2.5%	Rebalance	Buy	48	Long	$ 1,6
5	Bond Fund	VFSTX	-2.5%	Rebalance	Buy	37	Long	$
6	Bond Fund	VWEHX	-6.6%	Rebalance	Buy	48	Long	$
7	Bond Fund	VUSTX	-5.2%	Rebalance	Buy	10	Short	$
8	International Stock Fund	VDMIX	-1.9%	Rebalance	Hold	42	Long	$ (1,
9	Domestic Stock Fund	VEIPX	4.6%	Rebalance	Hold	22	Long	$ (
10	Domestic Stock Fund	VISGX	0.1%	OK	Hold	33	Long	$ 1,
11	Domestic Stock Fund	VIMSX	-0.2%	OK	Hold	46	Long	$
12	International Stock Fund	VTRIX	0.3%	OK	Hold	29	Long	$ 2,
13	International Stock Fund	VEIEX	0.8%	OK	Hold	9	Short	$ 2,
14	Individual Stock	TRV	2.8%	Rebalance	Sell	72	Long	$ 3,
15	Individual Stock	JNJ	4.9%	Rebalance	Sell	87	Long	$ 3,
16	Individual Stock	KO	3.4%	Rebalance	Hold	6	Short	$
17	Individual Stock	MSFT	-3.0%	Rebalance	Buy	50	Long	$
18	Individual Stock	IBM	5.1%	Rebalance	Sell	100	Long	$ 5,
19	*Total*					42.6		$ 21,
20								
21	Assumption Table							
22	Unrealized Gain Loss	0						
23	Target vs Actual Growth	-1%						
24								
25	Hold/Sell Criteria							
26	Buy Current vs. Target <	-1%						
27	Sell Target vs. Growth >=	1%						
28	Unrealized Gain/Loss >=	0						

Why?

Use AND or OR functions within IF functions

The benefit of using the AND or OR functions within the IF function is that doing so reduces the need to construct lengthy nested IF functions. It becomes increasingly difficult to manage the accuracy of lengthy nested IF functions. The AND and OR functions allow you to test for a variety of conditions in a cell location, which can reduce the need to nest multiple IF functions. Examine the nested if function in cell O4 on the **Investment Detail** worksheet. Can you recreate this without nesting the IF function?

Basic Conditional Formats

Follow-along file: Continue with Excel Objective 3.00. (Use file Excel Objective 3.07 if starting here.)

A feature related to the skills used to create logical functions is conditional formatting. Conditional formats allow you to apply a variety of formatting treatments based on the contents of a cell location. A logical test like the ones used in the IF, AND, and OR functions is used to evaluate the contents of a cell and apply a designated formatting treatment. For example, looking at Figure 3.20 "Completed Nested IF Function", you will notice that the Unrealized Gain/Loss column is formatted using the accounting number format. Negative numbers are enclosed in parentheses. However, to make these numbers stand out, we can

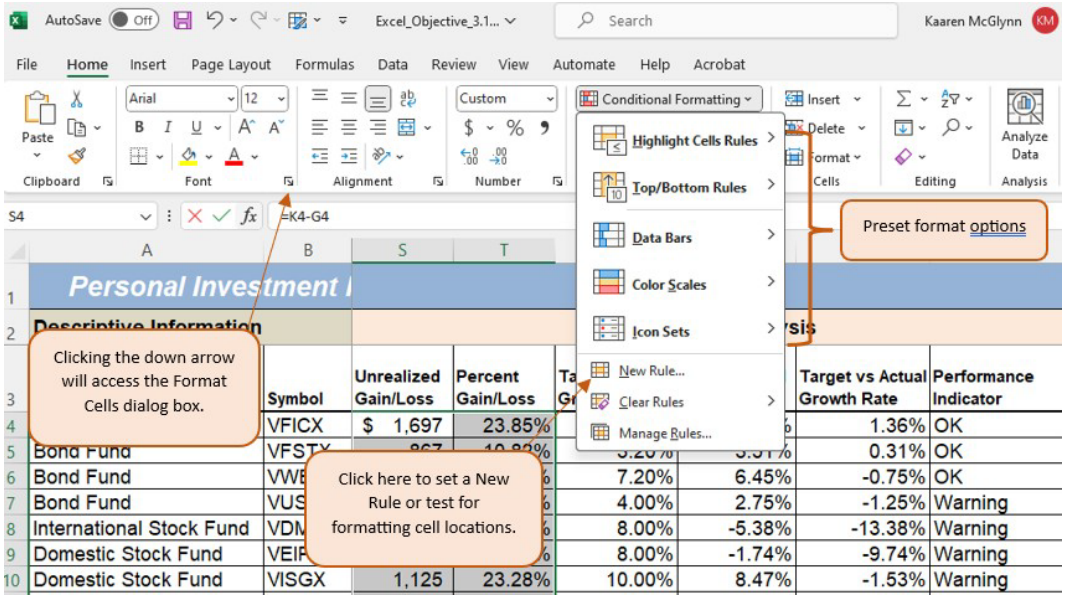
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

use conditional formatting to change the font color to red. We will do this for the Unrealized Gain/Loss and Percent Gain/Loss columns. The following steps explain how conditional formats are applied to the cell locations in these columns:

1. Highlight the range S4:T18 on the **Investment Detail** worksheet.
2. Click the Conditional Formatting button in the Styles group of commands on the Home tab of the Ribbon.
3. Click the New Rule command from the list of options. This will open the New Formatting Rule dialog box.

Excel for Mac – Conditional Formatting
Format ribbon > Conditional Formatting > in Manage rules click the **+** button > Choose the Classic option and change the pop-up menu to "Use a formula to determine which cells to format."

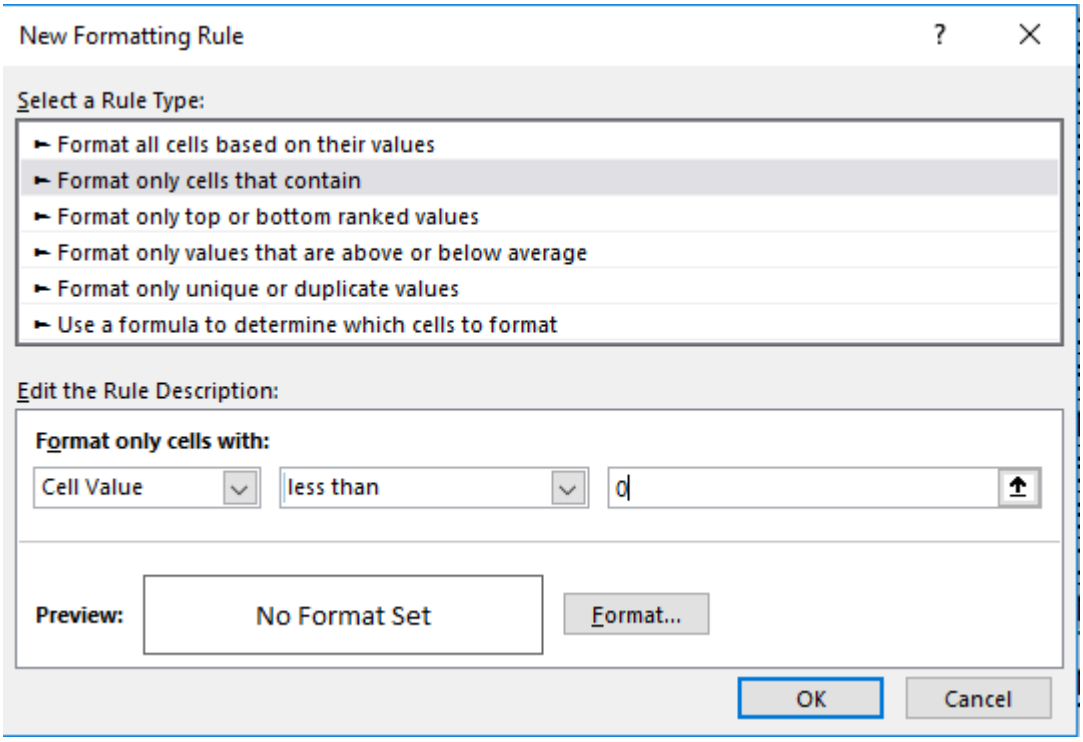
Figure 3.21 Conditional Formatting Options List



4. At the top of the New Formatting Rule dialog box, you will find a list of options under the Select a Rule Type heading. Click the second option that states "Format only cells that contain."
5. In the lower portions of the New Formatting Rule dialog box, you will see several drop-down boxes under the heading Edit the Rule Description. Make sure the first drop-down box is set to Cell Value.
6. Click the second drop-down box in the Edit the Rule Description section of the New Formatting Rule dialog box and select the "less than" option.
7. Click in the input box, which is next to the drop-down box that was set in the previous step and type a zero. This completes the logical test of the conditional format, which is going to evaluate if the value in any of the cells in the range S4:T18 is less than zero.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.21b New Formatting Rule Dialog Box

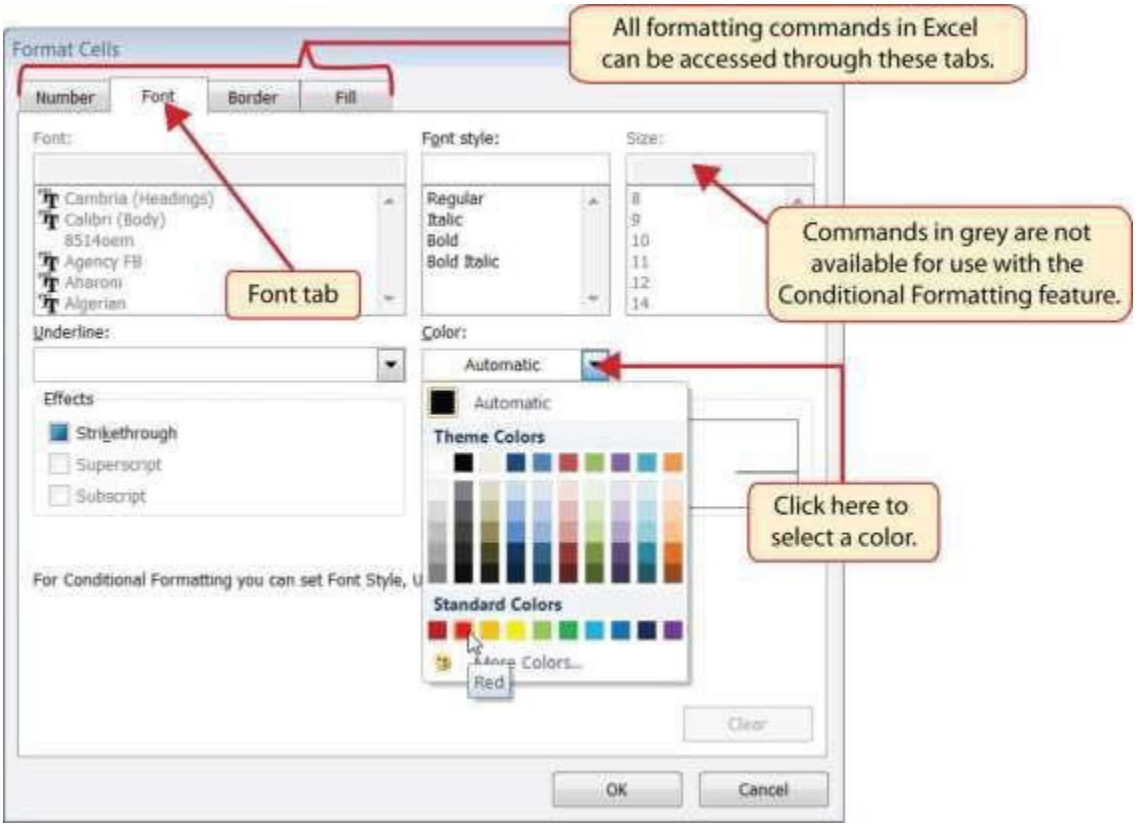


8. Click the Format button, which is near the bottom of the New Formatting Rule dialog box. This will open the Format Cells dialog box.
9. Click the drop-down box in the Color section of the Format Cells dialog box and select the red square from the color palette (see Figure 3.22 "Format Cells Dialog Box").
10. Click the OK button at the bottom of the Format Cells dialog box.
11. Click the OK button at the bottom of the New Formatting Rule dialog box. This completes the Conditional Formatting rule that will be applied to cells in the range S4:T18.
12. Figure 3.22 "Format Cells Dialog Box" shows the Format Cells dialog box. This opens when the Format button is clicked on the New Formatting Rule dialog box. Notice the tabs running across the top of the dialog box. All formatting features in Excel are grouped by category, which can be accessed by clicking the related tab on the Format Cells dialog box. You will see some of the formatting commands in lightgrey.

This indicates that these commands cannot be used with the Conditional Formatting feature. You can use the Format Cells dialog box to apply any formatting features by clicking the Format Cells dialog button on the Home tab of the Ribbon.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.22 Format Cells Dialog Box



Keyboard Shortcuts - Open the Format Cells Dialog Box

- Hold down the CTRL key wile pressing the SHIFT key and the letter F key on your keyboard.

Figure 3.23 "New Formatting Rule Dialog Box" shows the final settings for the New Formatting Rule dialog box. It is important to note that the “Format only cells that contain” option was selected in the New Formatting Rule dialog box to set a basic logical test that can be used to apply formatting commands automatically based on the values in cell locations.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.23 New Formatting Rule Dialog Box

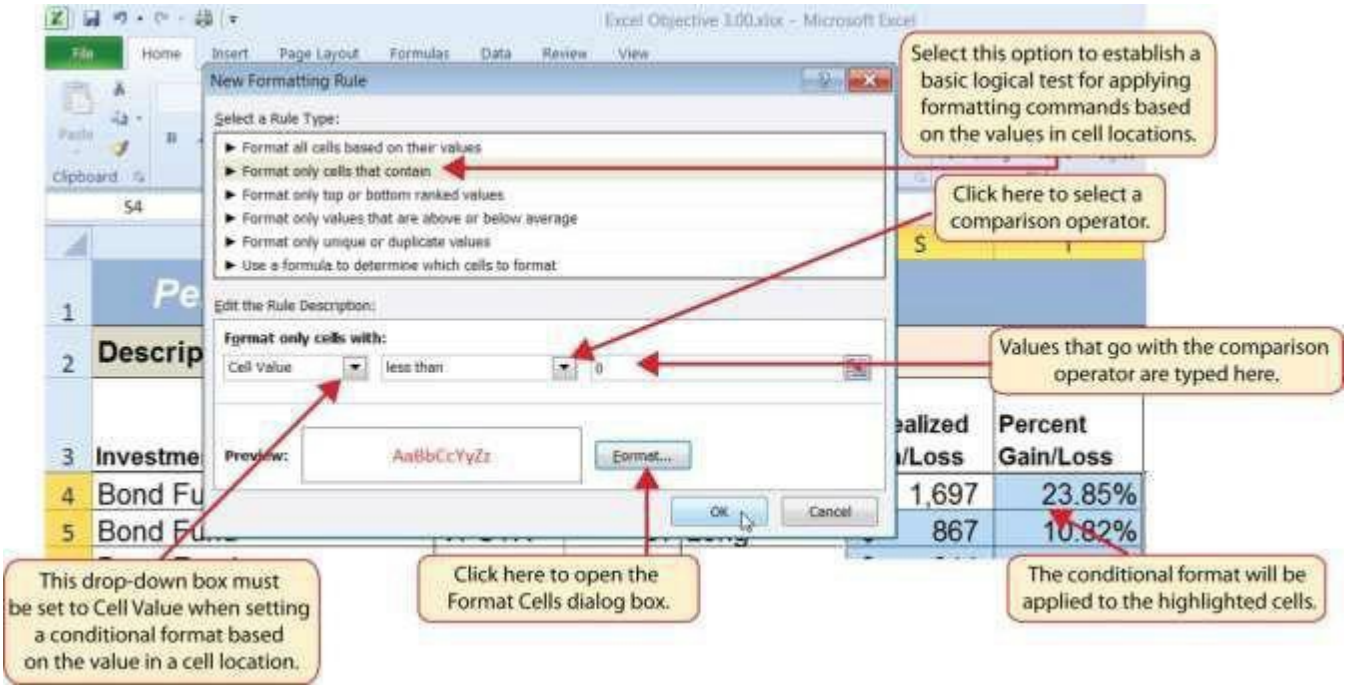
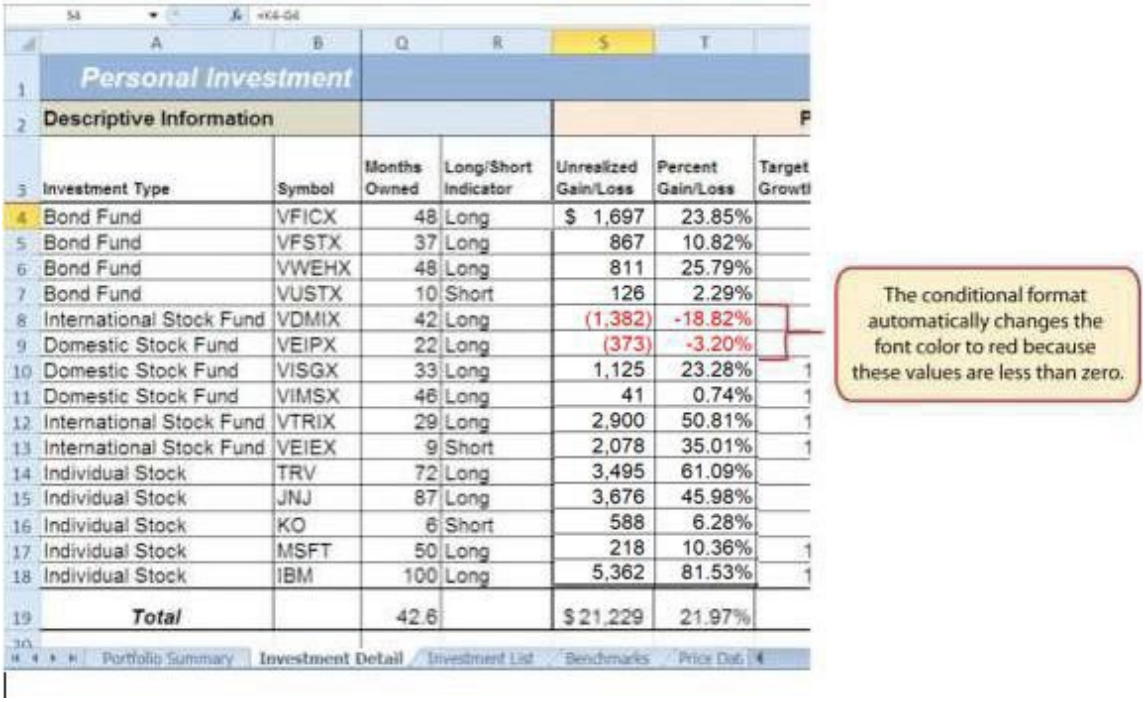

New Formatting Rule
Select a Rule Type:
Format all cells based on their values
Format only cells that contain
Format only top or bottom ranked values
Format only values that are above or below average
Format only unique or duplicate values
Use a formula to determine which cells to format
Edit the Rule Description:
Format only cells with:
Cell Value
less than
0
Preview:
AaBbCcYyZz
Format...
OK
Cancel
Select this option to establish a basic logical test for applying formatting commands based on the values in cell locations.
Click here to select a comparison operator.
Values that go with the comparison operator are typed here.
This drop-down box must be set to Cell Value when setting a conditional format based on the value in a cell location.
Click here to open the Format Cells dialog box.
The conditional format will be applied to the highlighted cells.

Figure 3.24 "Conditional Format Applied to the Range S4:T18" shows the results of the conditional formatting rule that was applied to the range S4:T18. Notice the font color is automatically changed to red for negative numbers.

Figure 3.24 Conditional Format Applied to the Range S4:T18



	Investment Type	Symbol	Months Owned	Long/Short Indicator	Unrealized Gain/Loss	Percent Gain/Loss	Target Growth
1	Personal Investment						
2	Descriptive Information						
4	Bond Fund	VFICX	48	Long	$ 1,697	23.85%	
5	Bond Fund	VFSTX	37	Long	867	10.82%	
6	Bond Fund	VWEHX	48	Long	811	25.79%	
7	Bond Fund	VUSTX	10	Short	126	2.29%	
8	International Stock Fund	VDMIX	42	Long	(1,382)	-18.82%	
9	Domestic Stock Fund	VEIPX	22	Long	(373)	-3.20%	
10	Domestic Stock Fund	VISGX	33	Long	1,125	23.28%	1
11	Domestic Stock Fund	VIMSX	46	Long	41	0.74%	1
12	International Stock Fund	VTRIX	29	Long	2,900	50.81%	1
13	International Stock Fund	VEIEX	9	Short	2,078	35.01%	1
14	Individual Stock	TRV	72	Long	3,495	61.09%	
15	Individual Stock	JNJ	87	Long	3,676	45.98%	
16	Individual Stock	KO	6	Short	588	6.28%	
17	Individual Stock	MSFT	50	Long	218	10.36%	1
18	Individual Stock	IBM	100	Long	5,362	81.53%	1
19	*Total*		42.6		$ 21,229	21.97%	

The conditional format automatically changes the font color to red because these values are less than zero.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Key Takeaways

- The Freeze Panes command should be used to lock column and row headings in place while strolling through large worksheets.
- The IF function is used to evaluate the contents of a cell location using a logical test. Based on the results of the logical test, you designate a custom output calculation to be performed by the function.
- When using text, or non-numeric data, to define any argument of the IF function, it must be placed inside quotation marks.
- A nested IF function is used when more than one logical test and more than two outputs are required for a project. Either the **Value_if_true** or the **Value_if_false** arguments can be defined with an IF function.
- When using percentages in any logical test or formula, you must use the percent symbol (**%**) or convert the percentage to a decimal. For example, 10% can also be expressed as .10.
- The OR function is used when many logical tests are required to evaluate the contents of a cell location. The OR function will produce a TRUE output if one of the logical tests is true.
- The AND function is used when many logical tests are required to evaluate the contents of a cell location. The AND function will produce a TRUE output if all of the logical tests are true.
- To minimize the complexity of nested IF functions, the OR and AND functions should be used, when possible, to define the *logical_test* argument of the IF function.
- The Freeze Panes command should be used to lock column and row headings in place while scrolling through large worksheets.
- The IF function is used to evaluate the contents of a cell location using a logical test. Based on the results of the logical test, you designate a custom output calculation to be performed by the function.
- When using text, or non-numeric data, to define any argument of the IF function, it must be placed inside quotation marks.
- A nested IF function is used when more than one logical test and more than two outputs are required for a project. Either the **Value_if_true** or the **Value_if_false** arguments can be defined with an IF function.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

- When using percentages in any logical test or formula, you must use the percent symbol (**%**) or convert the percentage to a decimal. For example, 10% can also be expressed as .10.
- The OR function is used when many logical tests are required to evaluate the contents of a cell location. The OR function will produce a TRUE output if one of the logical tests is true.
- The AND function is used when many logical tests are required to evaluate the contents of a cell location. The AND function will produce a TRUE output if all of the logical tests are true.
- To minimize the complexity of nested IF functions, the OR and AND functions should be used, when possible, to define the *logical_test* argument of the IF function.
- The Freeze Panes command should be used to lock column and row headings in place while scrolling through large worksheets.
- The IF function is used to evaluate the contents of a cell location using a logical test. Based on the results of the logical test, you designate a custom output or calculation to be performed by the function.
- When using text, or non-numeric data, to define any argument of the IF function, it must be placed inside quotation marks.
- A nested IF function is used when more than one logical test and more than two outputs are required for a project. Either the **Value_if_true** or the **Value_if_false** arguments can be defined with an IF function.
- When using percentages in any logical test or formula, you must use the percent symbol (**%**) or convert the percentage to a decimal. For example, 10% can also be expressed as .10.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

3.2 Statistical IF Functions

LEARNING OBJECTIVES
1. Use the COUNTIF function to count selected nonblank cells in a range based on one criteria argument. 2. Use the AVERAGEIF function to calculate the average of selected cells in a range based on the values in an alternate range of cells and one criteria argument. 3. Use the SUMIF function to calculate the sum of selected cells in a range based on the values in an alternate range of cells and one criteria argument. 4. Use the COUNTIFS function to count selected nonblank cells in a range based on more than one criteria argument that utilizes a logical test. 5. Use the AVERAGEIFS function to calculate the average of selected cells in a range based on the values in an alternate range of cells using more than one criteria argument that utilizes a logical test. 6. Use the SUMIFS function to calculate the sum of selected cells in a range based on the values in an alternate range of cells using more than one criteria argument that utilizes a logical test.

This section will demonstrate the use of statistical IF functions. Statistical IF functions provide you with the ability to evaluate the contents in a cell location before including them in a mathematical calculation. This allows you to selectively include targeted cell locations when executing statistical calculations such as sum, average, count, and so on. We will use several statistical IF functions to construct the **Portfolio Summary** worksheet shown in Figure 3.1 "Completed Personal Investment Portfolio Workbook", which contains two main sections. The Total Summary section (Rows 2 through 8) shows an overview for all investments in the portfolio by investment type. This will allow us to compare the growth performance among the Bond Funds, Domestic Stock Funds, and others. The Poor Performing Investments section (Rows 9 through 15) will provide an overview of poor performing investments by investment type. For the purposes of this exercise, we will define a poor performing investment as one where the growth rate is below the target growth rate by more than 1% (see Column W on the **Investment Detail** worksheet). The statistical IF functions will allow us to establish criteria to select targeted investments that can be included in the calculations for each section of the **Portfolio Summary** worksheet.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

The COUNTIF Function

Follow-along file: Continue with Excel Objective 3.00. (Use file Excel Objective 3.08 if starting here.)

The COUNTIF function differs from the regular COUNT function in two ways. First, the regular COUNT function counts only the number of cells in a range that contains numeric data. The COUNTIF function counts the number of cells in a range that contains numerical or text data. Second, the COUNTIF function allows you to selectively count the cells in a range based on specific criteria.

The COUNTIF function contains two arguments: **range** and **criteria**.

- The **range** argument is defined by the range of cells that will be counted.
- The **criteria** argument is defined with the criteria that will be used to decide if a cell in the range should be included in the output of the function.

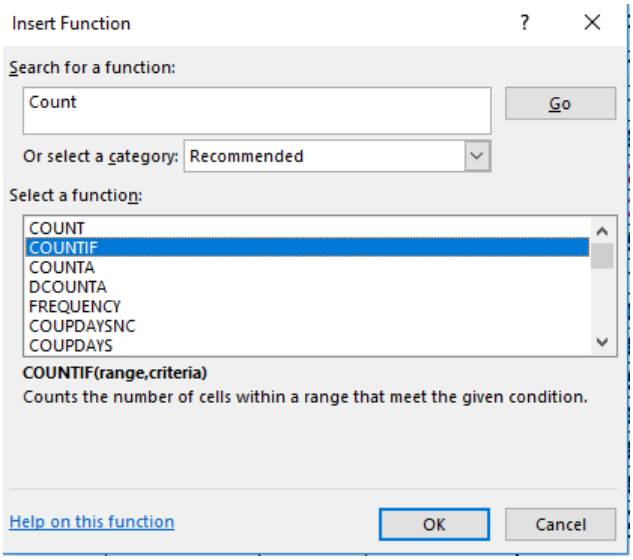
In the Portfolio Summary worksheet, we want to count the number of investments of each type without having to rearrange our source data to accomplish the task. The advantage of using the COUNTIF function is that it does not matter how the source data is sorted. It will find a match for the criteria and add one to the running total it is calculating. We will also see the power of naming the ranges in the Investment Detail worksheet because it will make these functions much easier to construct.

The following steps explain how we can use the COUNTIF function to calculate the number of investments by investment type on the **Portfolio Summary** worksheet:

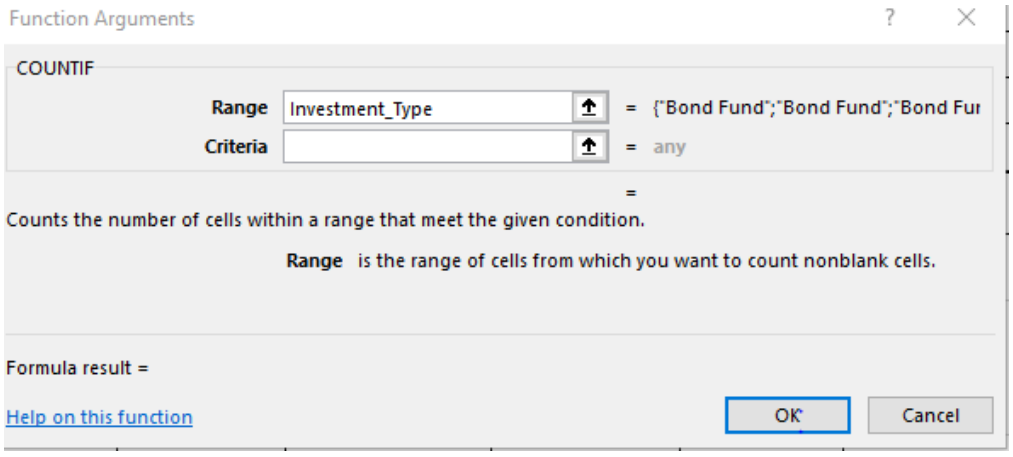
1. In the Investment Detail worksheet, select the range A3:A18 and ion the Formulas ribbon, use Create from Selection to name the range. Excel will create a named range: Investment_Type.
2. Click on the Portfolio Summary tab if the worksheet is not already active.
3. Click cell B4 on the Portfolio Summary worksheet.
4. Click the Formulas tab of the Ribbon.
5. Click the Insert Function button in the Function Library group of commands.
6. In the Search for a function box type COUNT, then click Go. A list of Excel functions that include the Count or an ability to count show in the Select a function box.
7. Click the scroll down arrow on the second drop-down list to find the COUNTIF function (see Figure 3.25 "Selecting the COUNTIF Function from the Function Library").

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.25 Selecting the COUNTIF Function from the Function Library



8. Click the COUNTIF function. This will open the Function Arguments dialog box.
9. Click in the **Range** argument on the Function Arguments dialog box and from the Formulas ribbon in the Defined Names section click the drop-down arrow next to Use in Formula. (See Figure 3.26 "Completed Function Arguments Dialog Box for the COUNTIF Function").
10. Select Investment Type from the drop-down list of named cells and ranges. After selecting it you will see a list of the investment types to the right of the Range box.

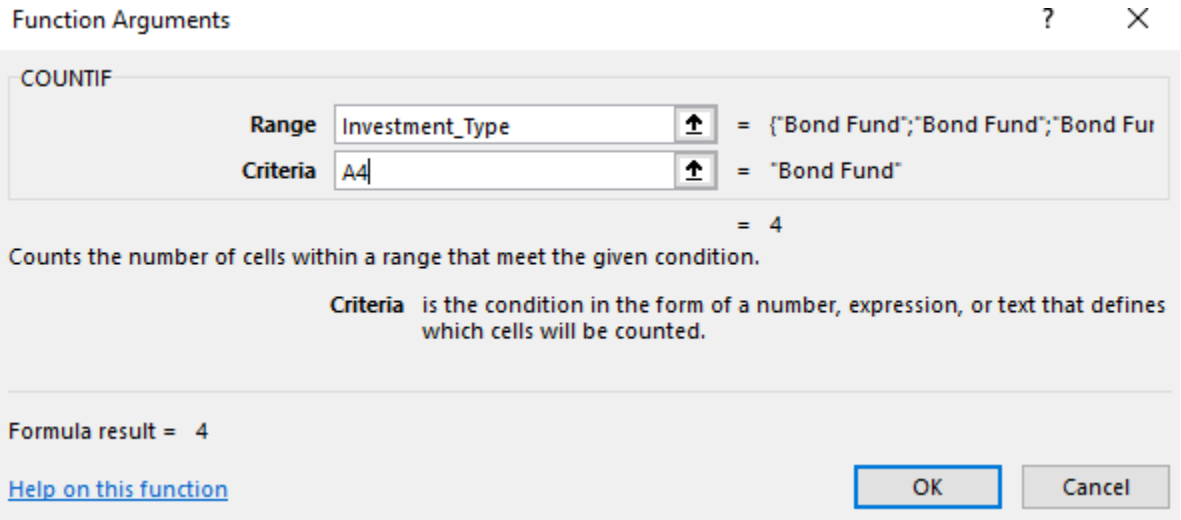


11. Press the TAB key on your keyboard to advance to the next argument, which is the **Criteria** argument. Then click on the cell location **A4**. The criteria for the function will be the investment type entered into cell A4 on the **Portfolio Summary** worksheet.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

12. Click the OK button at the bottom of the Function Arguments dialog box. Figure 3.26 "Completed Function Arguments Dialog Box for the COUNTIF Function" shows the completed Function Arguments dialog box for the COUNTIF function. Notice the absolute references that were placed on each cell location in the range that was used to define the **Range** argument. The **Criteria** argument is defined with the cell A4 (Bond Fund), which means the function will only count cell locations in the range A4:A18 where the contents in the cell match the contents in cell A4.

Figure 3.26 Completed Function Arguments Dialog Box for the COUNTIF Function


Function Arguments
COUNTIF
Range
Investment_Type
= {"Bond Fund";"Bond Fund";"Bond Fur
Criteria
A4
= "Bond Fund"
= 4
Counts the number of cells within a range that meet the given condition.
Criteria is the condition in the form of a number, expression, or text that defines which cells will be counted.
Formula result = 4
Help on this function
OK
Cancel

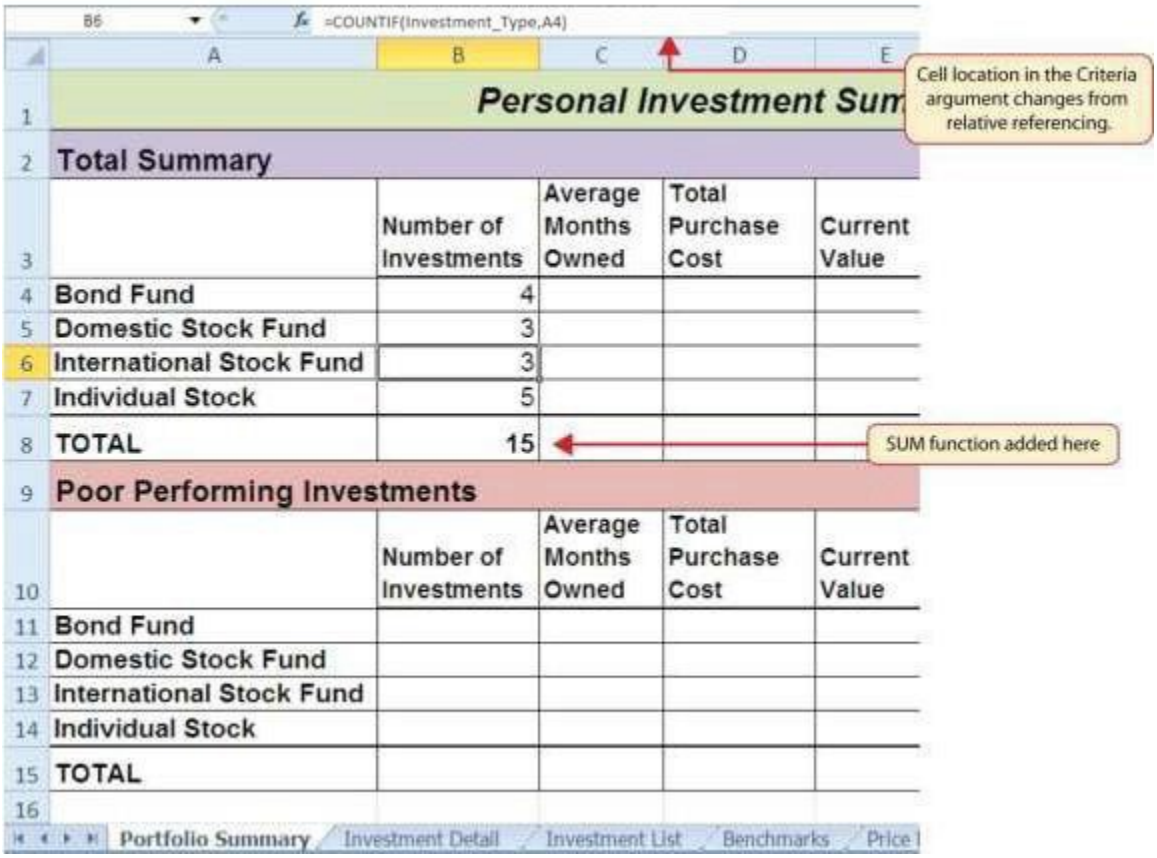
13. Copy the function in cell B4 and paste it into the range B5:B7. (You can copy the function because you have linked to the investment type in column A)

14. Enter a SUM function in cell B8 that sums the values in the range B4:B7.

Figure 3.27 "COUNTIF Function Output in the Portfolio Summary Worksheet "shows the results of the COUNTIF function after it is pasted into the range B5:B7. Because of relative referencing, the cell location used in the **criteria** argument is changed after the function is pasted into the range B5:B7. For example, in cell B6, the function is counting the cell locations in the range A4:A18 where the contents match the contents of cell A6. This allows you to use the function to count the number of investments per investment type. As shown in the figure, the range B4:B7 now shows the number of investments in this portfolio by investment type. Naming the range for the Range criteria creates an absolute range reference.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.27 COUNTIF Function Output in the Portfolio Summary Worksheet



The AVERAGEIF Function

Follow-along file: Continue with Excel Objective 3.00. (Use file Excel Objective 3.09 if starting here.)

The AVERAGEIF function performs the identical mathematical calculation as the regular AVERAGE function. However, unlike the COUNTIF function, it allows you to define criteria that will select cells in a different range that will be used in the function output.

The AVERAGEIF function differs from the COUNTIF function in that it allows you to define two cell ranges instead of one.

a. The first range pertains to the criteria that will be used to select cells for the function output.
b. The second range contains the values that will be used to calculate the arithmetic mean.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Table 3.8 "Arguments for the AVERAGEIF and SUMIF Functions" provides definitions for the arguments contained in the AVERAGEIF and SUMIF functions.

Table 3.8 Arguments for the AVERAGEIF and SUMIF Functions

Argument	Definition
Range	Range of cells that will be evaluated by the criteria argument.
Criteria	Criteria that will be used to evaluate the range of cells that is used to define the **Range** argument. This argument can be defined with a cell location, formula, number, text, or logical test. Note that text and logical tests must be enclosed in quotation marks.
[Average_range] or [Sum_range]	Range of cells that will be used to calculate the average when using the AVERAGEIF function, or the sum when using the SUMIF function. This argument is enclosed in brackets because it does not always need to be defined. If this argument is omitted, the function will use the range of cells in the **Range** argument to calculate the output.

The AVERAGEIF function will be used in the **Portfolio Summary** worksheet to calculate the average length of time that investments for each investment type are held. The following steps explain how to add this function to the worksheet:

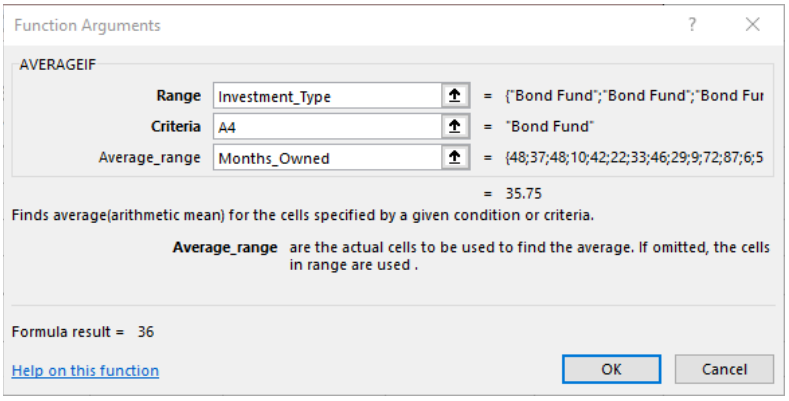
1. In the Investment Detail worksheet, select the range Q3:Q18 and ion the Formulas ribbon, use Create from Selection to name the range. Excel will create a named range: Months_Owned.
2. Go to the **Portfolio Summary** worksheet and click cellC4.
3. Click the Formulas tab of the Ribbon.
4. Click the Insert Function button in the Function Library group of commands.
5. In the Search for a function box type AVERAGE, then click Go. A list of Excel functions that include the AVERAGE or an ability to average show in the Select a function box.
6. Click the scroll down arrow on the second drop-down list to find the AVERAGEIF function.
7. Click in the **Range** argument on the Function Arguments dialog box and from the Formulas ribbon in the Defined Names section click the drop-down arrow next to Use in Formula. (See Figure 3.26 "Completed Function Arguments Dialog Box for the AVERAGEIF Function").

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

8. Select Investment Type from the drop-down list of named cells and ranges. After selecting it you will see a list of the investment types to the right of the Range box.
9. Press the TAB key on your keyboard to advance to the **Criteria** argument and type the cell location **A4**. The criteria for the function will be the investment type entered into cell A4 on the **Portfolio Summary** worksheet.
10. Click in the Average_Range box and from the Formula Ribbon, Defined Names section, click on the Use in Formula drop down arrow and select Months_Owned. (see Figure 3.28 "Defined Arguments for the AVERAGEIF Function").
11. Click the OK button at the bottom of the Function Arguments dialog box.

Figure 3.28 "Defined Arguments for the AVERAGEIF Function" shows the Function Arguments dialog box for the AVERAGEIF function that will be input into cell C4. Use of named ranges creates absolute cell references in the **Range** and **Average_range** arguments. The function will evaluate the cells in the range A4:A18 using the value that exists in cell A4 on the **Portfolio Summary** worksheet. When a cell in the range A4:A18 meets the criteria, the function will pull the cell location in the same row from the range Q4:Q18 and include it in the average calculation.

Figure 3.28 Defined Arguments for the AVERAGEIF Function



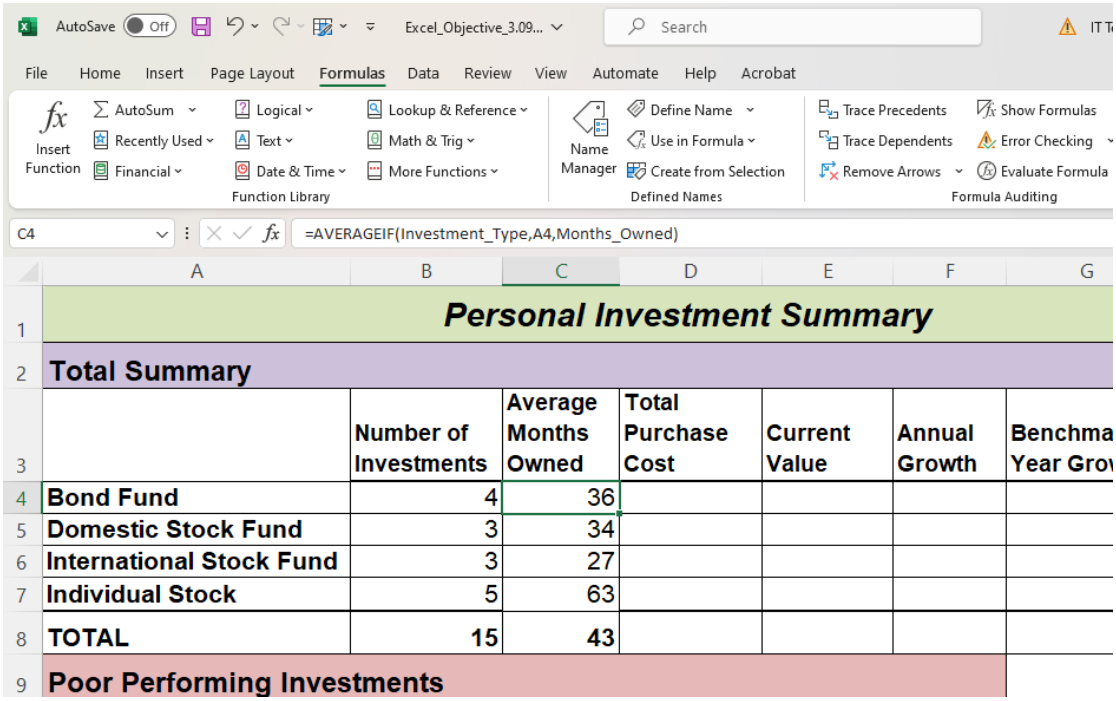
12. Copy the function in cell C4 and paste it into the range C5:C7 using the Paste Formulas option.
13. In cell C8 create an AVERAGE function that will average the months owned for all the investments in the portfolio by typing =AVERAGE(Months_Owned). *Note: You cannot add averages together because it creates a nonsense number. A number that has no meaning because it is out of context.*

Figure 3.29 "AVERAGEIF Function Output on the Portfolio Summary Worksheet" shows the output of the AVERAGEIF function in the Average Months Owned column on the **Portfolio Summary** worksheet.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

The function calculates the average months owned in Column Q on the **Investment Detail** worksheet where the investment type is equal to the description entered in the range A4:A7 on the **Portfolio Summary** worksheet.

Figure 3.29 AVERAGEIF Function Output on the Portfolio Summary Worksheet



	A	B	C	D	E	F	G
1	***Personal Investment Summary***						
2	**Total Summary**						
3		**Number of Investments**	**Average Months Owned**	**Total Purchase Cost**	**Current Value**	**Annual Growth**	**Benchma Year Grov**
4	**Bond Fund**	4	36				
5	**Domestic Stock Fund**	3	34				
6	**International Stock Fund**	3	27				
7	**Individual Stock**	5	63				
8	**TOTAL**	**15**	**43**				
9	**Poor Performing Investments**						

Integrity Check - Matching Row Numbers for the Range and Average_range (or Sum_range) Arguments

When defining the **Average_range** argument for the AVERAGEIF function or the **Sum_range** argument for the SUMIF function, it is good practice to make sure the row numbers match the row numbers used in the **Range** argument. For example, if the **Range** argument is defined with the range A4:A12, the range used to define the **Average_range** or **Sum_range** argument should begin with Row 4 and end with Row 12. If the row numbers in these two arguments do not match, Excel will include the values only in the rows used to define the **Range** argument. For example, if the **Range** argument is defined with the range A4:A12 and the **Average_range** (or **Sum_range**) argument is defined with the range D4:D20, only the values in cells D4:D12 will be included in the function output.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

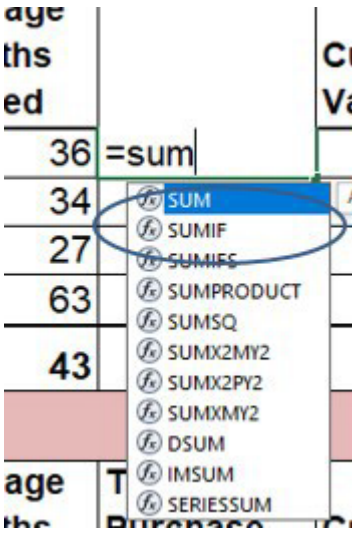
The SUMIF Function

Follow-along file: Continue with Excel Objective 3.00. (Use file Excel Objective 3.10 if starting here.)

The SUMIF function performs the same mathematical calculation as the regular SUM function. However, like the AVERAGEIF function, this function allows you to select specific cells from a range that will be used in the output. The arguments for the SUMIF function are identical to the AVERAGEIF function except instead of averaging the result, Excel will be adding the result. (see Table 3.8 "Arguments for the AVERAGEIF and SUMIF Functions").

We will use the SUMIF function in two columns on the Portfolio Summary worksheet. The first column will show the total investment cost for each investment type. The second column will show the total current value for each investment type. This will allow us to calculate the total annual growth rate for each investment type. The following steps explain how we will use this function to complete the first column:

1. On the Investment Detail worksheet highlight the Cost of Purchase range G3:G18 and, holding the Ctrl key, select the Current Purchase Value range K3:K18. From the Formula ribbon, Defined Names section, Click on Create from Selection. Make sure top row is selected and OK.
2. Go to the **Portfolio Summary** worksheet and click cellD4.
3. In cell D4 type an = sum. You will see a list of functions or named cells that start with the letters sum. Double click on the SUMIF from the list of functions.



4. The first argument in the function is the range that will be used to find a match to the criteria. In this case it will be the named range Investment_Type. We will access this named range by typing the name in the function. When you see the named range appear in the drop-down list of Function and named ranges, double click the named range to insert it into your function.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

5. Type a comma.
6. The next argument is the Criteria, click in cell A4 and then type another comma.
7. From the Use in Formula drop down on the Formulas ribbon, select the named range Cost_of_Purchase.
8. Type your closing parenthesis ()).

```
=SUMIF(Investment_Type,A4,Cost_of_Purchase)
```

9. Copy the function in cell D4 and paste it into the range D5:D7.
10. While the range D5:D7 is selected, format Comma with zero decimal places.
11. Use AutoSum to total the column in cell D8.
12. Format the top and total row with a $ and zero decimal places. Format the cells D5:D7 comma style with zero decimal places.

To complete the Current Value data on the Portfolio Summary worksheet, follow the steps above except we will use the Current Investment Value range K3:K18 from the Investment Detail worksheet and use that range in our new SUMIF.

1. On the **Portfolio Summary** worksheet and click cell E4.
2. In cell E4 type an = sum. You will see a list of functions or named cells that start with the letters sum. Double click on the SUMIF from the list of functions.
3. The first argument in the function is the range that will be used to find a match to the criteria. In this case it will be the named range Investment_Type. We will access this named range by typing the name in the function. When you see the named range appear in the drop-down list of Function and named ranges, double click the named range to insert it into your function.
4. Type a comma.
5. The next argument is the Criteria, click in cell A4 and then type another comma.
6. From the Use in Formula drop down on the Formulas ribbon, select the named range Current_Investment_Value.
7. Type your closing parenthesis **)**.

```
=SUMIF(Investment_Type,A4,Current_Investment_Value)
```

8. Copy the function in cell E4 and paste it into the range E5:E7.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

9. Use AutoSum to total the column in cell E8.
10. Format the top and total row with a $ and zero decimal places.
11. Format the cells E5:E7 comma style with zero decimal places.

Figure 3.31 "SUMIF Function Outputs in the Portfolio Summary Worksheet" shows the results of the SUMIF function in the Total Purchase Cost and Current Value columns in the **Portfolio Summary** worksheet.

Figure 3.31 SUMIF Function Outputs in the Portfolio Summary Worksheet

Personal Investment Summary

Total Summary

	Number of Investments	Average Months Owned	Total Purchase Cost	Current Value	An Gr
Bond Fund	4	36	$ 23,773	$ 27,274	
Domestic Stock Fund	3	34	22,110	22,903	
International Stock Fund	3	27	18,983	22,578	
Individual Stock	5	63	31,763	45,101	
TOTAL	**15**	**43**	**$ 96,628**	**$117,857**	

Integrity Check – Formula Results

The result formulas in cells D8:E8 for the Total Purchase Cost and Current Values on the Portfolio Summary must equal the totals from the Investment Detail worksheet cells G19 and K19. If they don't, your named ranges may be incorrect.

A formula can now be added to show the annual growth for each investment category. The following steps explain how to add this formula to the **Portfolio Summary** worksheet:

A few things to know before you begin. When creating a percent change between an old value (in this case the Purchase Cost) and the new value (Current Value) you always subtract the old from the new, then divide by the old. The formula would look like:

=(new value-old value)/old value

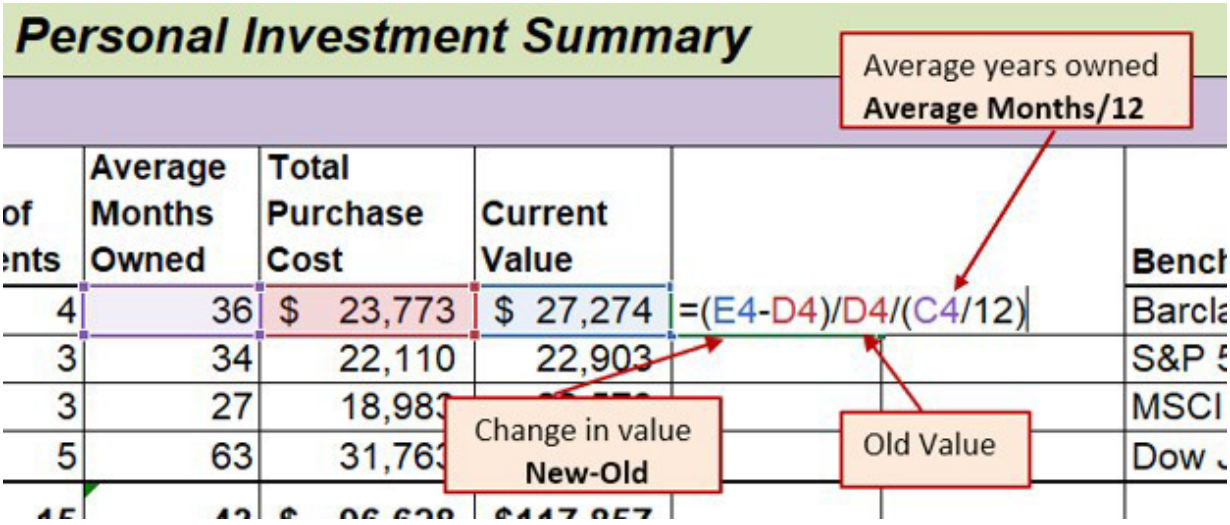
The (new value – old value) is the amount of change that has occurred.

Remember back to the order of operations. For this formula to work correctly Excel must subtract before it does the division. We will force our formula to do that by enclosing the subtraction inside parenthesis which will tell Excel to do the subtraction first.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

The steps to accomplish this are:

1. Click cell F4 on the **Portfolio Summary** worksheet.
2. Type an equal sign (=) followed by two open parentheses **((**.
3. Click cell E4 and type a minus sign (−).
4. Click cell D4 and type a closing parenthesis).
5. Type a slash (/) for division and click cell D4.
6. Type a closing parenthesis). This completes the first part of the formula, which is calculating the growth rate between the Total Purchase Cost (cell D4) and the Current Value (cell E4).
7. Type a slash (/) for division followed by an open parenthesis **(()**.
8. Click cell C4, which is the Average Months owned.
9. Type a slash (/) for division and the number **12**. This part of the formula converts the number of months owned to years by dividing it by 12. This result is being divided into the growth rate, which will then show the average growth per year.
10. Type a closing parenthesis **())** and press the ENTER key on your keyboard.



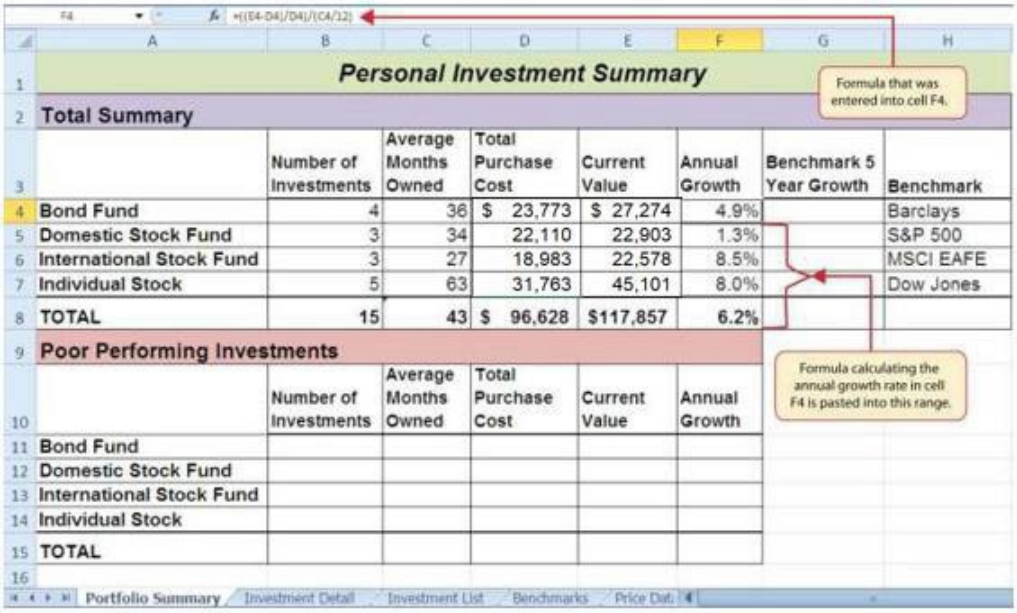
.

11. Copy the formula in cell F4 and paste it into the range F5:F8 using the Paste Formulas command.

Figure 3.32 "Completed Annual Growth Column in the Portfolio Summary Worksheet" shows the results of the statistical IF functions that were added to the Total Summary section of the **Portfolio Summary** worksheet. The statistical IF functions used on this worksheet allowed us to group the details in the **Investment Detail** worksheet by investment type. Once this was accomplished, we added a formula to show the annual growth rate by investment type.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.32 Completed Annual Growth Column in the Portfolio Summary Worksheet



	A	B	C	D	E	F	G	H
1	Personal Investment Summary							
2	Total Summary							
3		Number of Investments	Average Months Owned	Total Purchase Cost	Current Value	Annual Growth	Benchmark 5 Year Growth	Benchmark
4	Bond Fund	4	36	$ 23,773	$ 27,274	4.9%		Barclays
5	Domestic Stock Fund	3	34	22,110	22,903	1.3%		S&P 500
6	International Stock Fund	3	27	18,983	22,578	8.5%		MSCI EAFE
7	Individual Stock	5	63	31,763	45,101	8.0%		Dow Jones
8	TOTAL	15	43	$ 96,628	$117,857	6.2%		
9	Poor Performing Investments							
10		Number of Investments	Average Months Owned	Total Purchase Cost	Current Value	Annual Growth		
11	Bond Fund							
12	Domestic Stock Fund							
13	International Stock Fund							
14	Individual Stock							
15	TOTAL							
16								

Portfolio Summary | Investment Detail | Investment List | Benchmarks | Price Dat

The COUNTIFS Function

Follow-along file: Continue with Excel Objective 3.00. (Use file Excel Objective 3.11 if starting here.)

Up to this point, the statistical IF functions that were demonstrated provided the ability to define one criteria or logical test used to select cells from a targeted range. The next set of statistical functions that will be demonstrated provides the ability to define multiple sets of criteria for selecting cells from a targeted range. These multiple sets of criteria act like an AND function. All the criteria must be TRUE to be included in the function results. We will begin with the COUNTIFS function.

It is easy to distinguish the difference between a statistical IF function that allows one criteria argument to be defined and one that allows multiple criteria arguments. If the IF at the end of the function name is plural, you can define multiple sets of criteria arguments.

Therefore, the COUNTIF*S* function provides the option of defining multiple sets of criteria for selecting cells from a targeted range that will be used in the function output.

The arguments for the COUNTIFS function are established in pairs. For example, the first arguments for the function are **Criteria_range1** and **Criteria1**. The function will use the **Criteria1** argument to select cells in the **Criteria_range1** argument. A second pair of arguments, **Criteria_range2** and **Criteria2**, can be defined to select a subset of cell locations that were selected in the **Criteria_range1** and **Criteria1** arguments. This process can be repeated for several pairs of criteria arguments.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

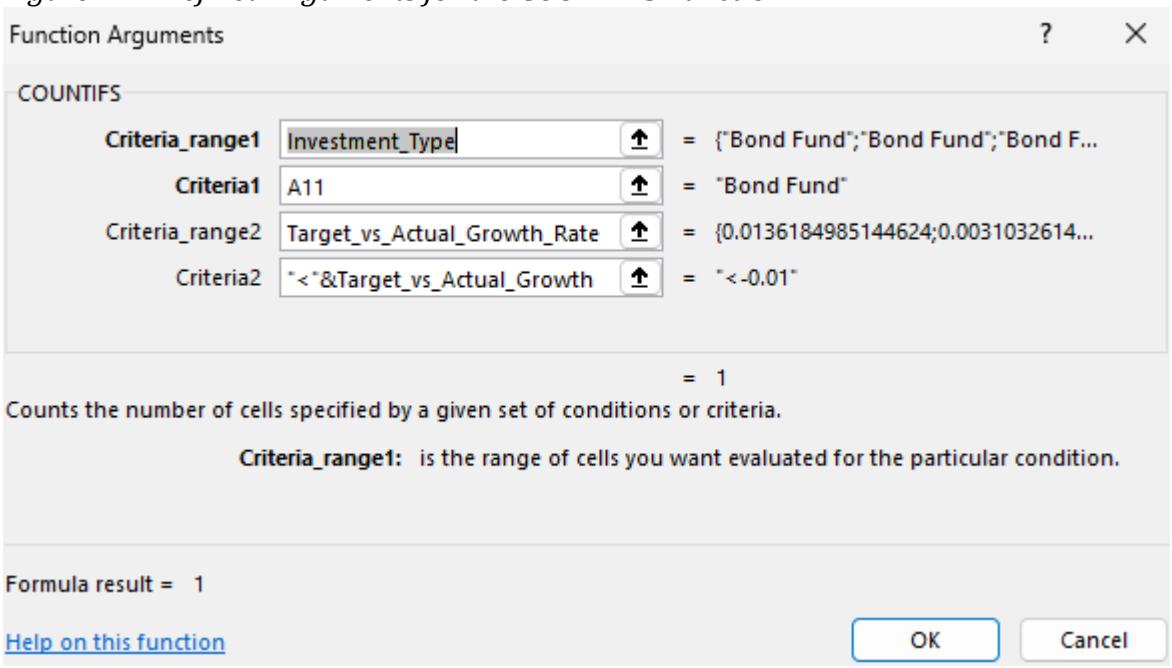
We will continue to work on the **Portfolio Summary** worksheet by adding the COUNTIFS function to count the number of poor performing investments by investment type. The criteria for determining if an investment is poor performing is if the Targeted vs. Actual Growth rate is less than **-1%.** The following steps explain how to add this function to the worksheet:

1. First, we will establish our assumption table. In cell A17 type Poor Performing Investment Criteria
2. In cell A18 type "Target vs Actual Growth <".
3. In cell B18 type **-1%** *(Note: This is for informational purposes only).*
4. Highlight Cells A15:B18 and use Create from Selection to name the criteria.
5. Click cell B11 on the **Portfolio Summary** worksheet.
6. Click the Formulas tab of the Ribbon.
7. Click the More Functions button in the Function Library group of commands.
8. Place the mouse pointer over the Statistical option from the drop-down list.
9. Click the scroll down arrow on the second drop-down list to find the COUNTIFS function.
10. Click the COUNTIFS function. This will open the Function Arguments dialog box.
11. Click in the **Criteria_range1** argument on the Function Arguments dialog box and then from the Use in Formulas option on the Formulas ribbon select the named range Investment_Type.
12. Press the TAB key on your keyboard to advance to the **Criteria1**argument and click on cell **A11 (Bond Fund)**. The criteria for the function will be the investment type that is entered into cell A11 on the **Portfolio Summary** worksheet. Notice that when you define this argument, the **Criteria_range2** argument will appear on the Function Arguments dialog box.
13. Click in the **Criteria_range2** argument on the Function Arguments dialog box.
14. From the Use in Formula drop down select the named range Target_vs_Actual_Growth_Rate. You should see a string of numbers to the right of the range box.
15. Press the TAB key on your keyboard to advance to the**Criteria2**argument.
16. Type an open quotation mark followed by the inequality **<.** Put in another quotation mark, the **&** and from the Use in Formula drop-down, select Target_vs_Actual_Growth_Rate. Then type a closing quotation mark. (**"<"&Target_vs_Actual Growth**). The second criterion for this function is a logical test that will identify cell locations where the value is less than −1%. For the purposes

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

of this exercise, a poor performing investment is one that is below the target growth rate by more than 1%.

Figure 3.33 Defined Arguments for the COUNTIFS Function



17. Click the OK button at the bottom of the Function Arguments dialog box.
18. Copy the function in cell B11 into the range B12:B14.
19. Enter a SUM function in cell B15 on the **Portfolio Summary** worksheet that sums the values in the range B11:B14.

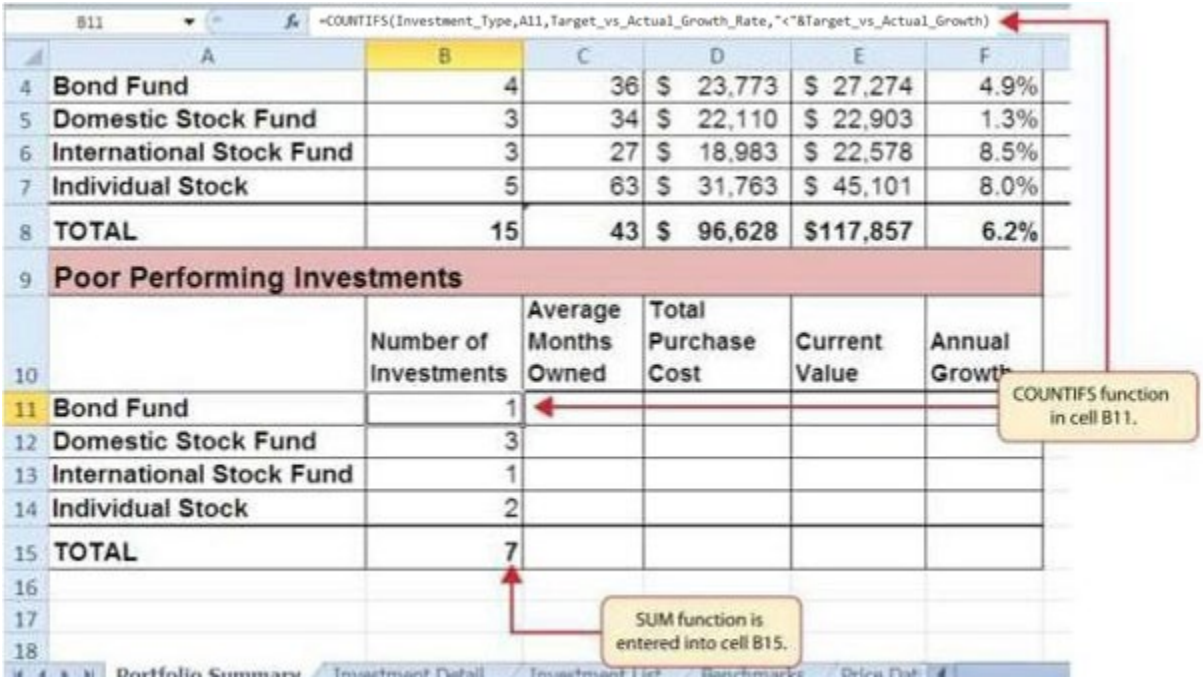
Why?

Use Statistical IF Functions for a Summary Worksheet

When creating a summary worksheet that summarizes detailed data from other worksheets it is best to use statistical IF functions. If data is added to the detailed worksheet that is being summarized, the statistical IF functions will automatically include the new data in the summary worksheet. For example, suppose a row is added below Row 7 on the **Investment Detail** and another bond investment is added. The statistical IF functions will automatically pick up the new investment and include it in the **Portfolio Summary** worksheet. If regular statistical functions or formulas are used, the summary worksheet can easily become inaccurate if new data is added to the detailed worksheet or if the sort order is changed.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.34 Outputs for the COUNTIFS Functions


B11
=COUNTIFS(Investment_Type,A11,Target_vs_Actual_Growth_Rate,"<"&Target_vs_Actual_Growth)
Bond Fund 4 36 $ 23,773 $ 27,274 4.9%
Domestic Stock Fund 3 34 $ 22,110 $ 22,903 1.3%
International Stock Fund 3 27 $ 18,983 $ 22,578 8.5%
Individual Stock 5 63 $ 31,763 $ 45,101 8.0%
TOTAL 15 43 $ 96,628 $117,857 6.2%
Poor Performing Investments
Number of Investments
Average Months Owned
Total Purchase Cost
Current Value
Annual Growth
Bond Fund 1
Domestic Stock Fund 3
International Stock Fund 1
Individual Stock 2
TOTAL 7
COUNTIFS function in cell B11.
SUM function is entered into cell B15.

Skill Refresher - COUNTIFS

1. Type an equal sign (=
2. Type the function COUNTIFS followed by an open parenthesis **(**.
3. Define the Criteria_range argument with a range of cells that will be counted.
4. Type a comma.
5. Define the Criteria1 argument with a cell location, number, text, or logical test. Text and logical tests must be enclosed in quotation marks. This argument will be used to select cells from the Criteria_range argument.
6. Type a comma and then repeat steps 3, 4, and 5 to define as many pairs of arguments as needed.
7. Type a closing parenthesis.
8. Press the enter key on your keyboard.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

The AVERAGEIFS Function

Follow-along file: Continue with Excel Objective 3.00. (Use file Excel Objective 3.12 if starting here.)

The AVERAGEIFS function is like the COUNTIFS function in that multiple sets of criteria can be defined instead of one. However, the arguments for the AVERAGEIFS function are slightly different from those for the COUNTIFS function. Table 3.9 "Arguments for the AVERAGEIFS and SUMIFS Functions" provides definitions for the arguments of the AVERAGEIFS and the SUMIFS functions.

Table 3.9 Arguments for the AVERAGEIFS and SUMIFS Functions

Argument	Definition
Average_range or Sum_range	Range of cells that contain values to be averaged when using the AVERAGEIFS function or summed when using the SUMIFS function. Note that the AVERAGEIFS or SUMIFS functions will only select values from the range used to define this argument if all criteria pairs are true.
Criteria_range1	Range of cells that will be evaluated based on the **Criteria1** argument to determine which cells in the **Average_range** or **Sum_range** arguments will be included in the output of the function.
Criteria1	Criteria that will be used to evaluate the range of cells used to define the **Criteria_range1** argument. This argument can be defined with a cell location, formula, number, text, or logical test. Note that text and logical tests must be enclosed in quotation marks.
Criteria_range2	Optional argument that defines a second range of cells that will be evaluated based on the **Criteria2** argument to determine which cells in the **Average_range** or **Sum_range** arguments will be included in the output of the function. Additional **Criteria_range** arguments can be defined as needed.
Criteria2	Criteria that will be used to evaluate the range of cells used to define the **Criteria_range2** argument. This argument can be defined with a cell location, formula, number, text, or logical test. Note that text and logical tests must be enclosed in quotation marks. Additional **Criteria N** arguments can be defined as needed.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

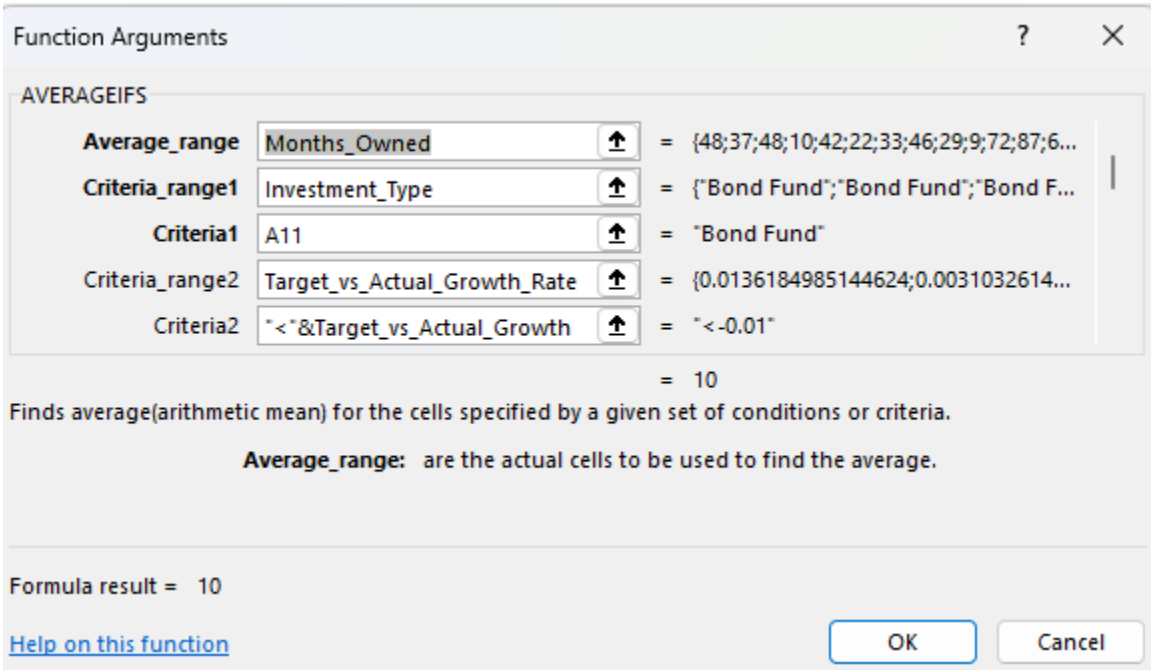
The AVERAGEIFS function will be used to calculate the average months of ownership for poor performing investments in the portfolio. The following steps explain how to add this function to the **Portfolio Summary** worksheet:

1. Click cell C11 on the **Portfolio Summary** worksheet.
2. Click the Formulas tab on the Ribbon.
3. Click the More Functions button in the Function Library group of commands.
4. Place the mouse pointer over the Statistical option from the drop-down list.
5. Click the AVERAGEIFS function near the top of the list of functions. This will open the Function Arguments dialog box.
6. Click in the **Average_range** argument on the Function Arguments dialog box.
7. From the Use in Function on the Functions Ribbon select the named range Months_Owned. Selected cells from this range will be averaged by the function based on the defined criteria in ensuing arguments.
8. Click in the **Criteria_range1** argument on the Function Arguments dialog.
9. From the Use in Function on the Functions Ribbon select the named range Investment_Type.
10. Press the TAB key on your keyboard to advance to the **Criteria1** argument and click on cell **A11**. The criteria for the function will be the investment type entered into cell A11 on the **Portfolio Summary** worksheet. You will notice that as you define this argument, the **Criteria_range2** argument will appear on the Function Arguments dialog box.
11. Click in the **Criteria_range2** argument on the Function Arguments dialog box.
12. From the Use in Function on the Functions Ribbon select the named range Target_vs_Actual_Growth_Rate.
13. Press the TAB key on your keyboard to advance to the **Criteria2** argument.
14. Type an open quotation mark followed by the logical test <−1% and then type a closing quotation mark (**"<"&Target_vs_Growth"**). The second criterion for this function is a logical test that will identify cell locations where the value is less than −1%. For the purposes of this exercise, a poor performing investment is one that is below the target growth rate by more than -1%.
15. Click the OK button at the bottom of the Function Arguments dialog box.
16. Copy the function in cell C11 and paste it into the range C12:C14 using the Paste Formulas command.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.35 "Completed Arguments for the AVERAGEIFS Function" shows the defined arguments for the AVERAGEIFS function. Notice that two sets of criteria arguments are defined. Values that meet all criteria defined in the function will be selected from the named range Months_Owned.

Figure 3.35 Completed Arguments for the AVERAGEIFS Function

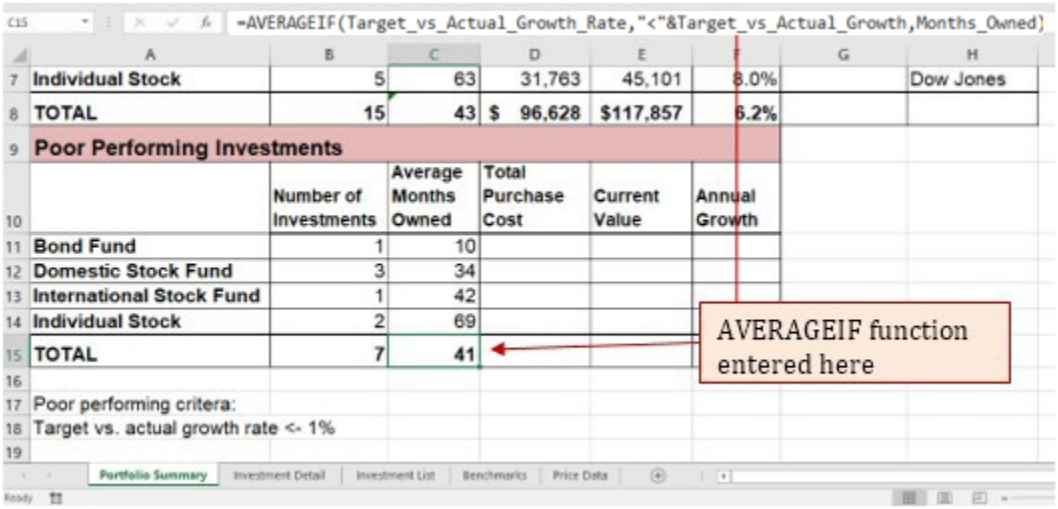


43. Enter an AVERAGEIF function in cell C15 by typing an equal sign (=) followed by the function name **AVERAGEIF** followed by an open parenthesis(**(**).
44. Use the named range Target_vs_Actual_Growth_Rate to define the Range argument. Type a comma.
45. Type the following to define the criteria argument: **"<"&Target_vs_Actual_Growth,** Type a comma.
46. Use the named range Months_Owned to define the [Average_range] argument. Then type a closing parenthesis (**)**) and press the ENTER key on your keyboard.

Figure 3.36 "Results of the AVERAGEIFS Function" shows the results of the AVERAGEIFS function in the **Portfolio Summary** worksheet. The function shows the average months of ownership for the poor performing investments by investment type.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.36 Results of the AVERAGEIFS Function



	A	B	C	D	E	F	G	H
7	Individual Stock	5	63	31,763	45,101	8.0%		Dow Jones
8	TOTAL	15	43	$ 96,628	$117,857	6.2%		
9	Poor Performing Investments							
10		Number of Investments	Average Months Owned	Total Purchase Cost	Current Value	Annual Growth		
11	Bond Fund	1	10					
12	Domestic Stock Fund	3	34					
13	International Stock Fund	1	42					
14	Individual Stock	2	69					
15	TOTAL	7	41					
16								
17	Poor performing critera:							
18	Target vs. actual growth rate <- 1%							
19								

Portfolio Summary | Investment Detail | Investment List | Benchmarks | Price Data

Skill Refresher – AVERAGEIFS

1. Type an equal sign (**=**).
2. Type the function name **AVERAGEIFS** followed by an open parenthesis (**(**).
3. Define the **Average_range** argument with a range of cells that contain values to be averaged.
4. Type a comma.
5. Define the **Criteria_range1** argument with a range of cells that will be evaluated based on the criteria used to define the **Criteria1** argument.
6. Type a comma.
7. Define the **Criteria1** argument with a cell location, number, text, or logical test. Text and logical tests must be enclosed in quotation marks.
8. Repeat steps 4, 5, 6, and 7 to define as many pairs of criteria arguments as needed.
9. Type a closing parenthesis **)**.
10. Press the ENTER key on your keyboard.
11. Criteria using operating symbols such as **>= , <=, =** must be enclosed in quotes followed by the & then the cell reference.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

The SUMIFS Function

Follow-along file: Continue with Excel Objective 3.00. (Use file Excel Objective 3.13 if starting here.)

The SUMIFS function is like the AVERAGEIFS function in that multiple criteria arguments can be defined to select cells from a targeted range. The function will use the selected cells from this targeted range to calculate a total or sum.

The SUMIFS function will be used to complete the Total Purchase Cost and Current Value columns in the Poor Performing Investments section of the **Portfolio Summary** worksheet. The following steps explain how to construct this function for the Total Purchase Cost column:

1. Click cell D11 on the **Portfolio Summary** worksheet.
2. Click the Formulas tab on the Ribbon.
3. From the Insert Function select SUMIFS. This will open the Function Arguments dialog box.
4. In the **Sum_range argument** on the Function Arguments dialog box, use the Use in Formulas to select the named range **Cost_of_Purchase**. Selected cells from this range will be summed based on the defined criteria in ensuing arguments.
5. Click in the **Criteria_range1** argument on the Function Arguments dialog and use the named range Investment_Type from the Use in Formulas on the Formulas ribbon. Once the **Criteria_range1** argument is defined, the **Criteria1** argument will appear in the Function Arguments dialog box.
6. Press the TAB key on your keyboard to advance to the **Criteria1** argument and type the cell location **A11**. The criteria for the function will be the investment type that is entered into cell A11 on the **Portfolio Summary** worksheet. You will notice that as soon as you define this argument, the **Criteria_range2** argument will appear on the Function Arguments dialog box.
7. In the **Criteria_range2** argument on the Function Arguments dialog box use the named range Target_vs_Actual_Growth_Rate
8. Press the TAB key on your keyboard to advance to the **Criteria2** argument.
9. Type **"<"&Target_vs_Actual_Growth.**. The second criterion for this function is a logical test that will identify cell locations where the value is less than −1%. For the purposes of this exercise, a poor performing investment is one that is below the target growth rate by more than -1%.
10. Click the OK button at the bottom of the Function Arguments dialog box.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

11. Copy the function in cell D11 into the range D12:D14. Format the cells D12LD14 with a comma style and no decimal places.
12. Enter a regular SUM function in cell D15 on the **Portfolio Summary** worksheet that sums the values in the range D11:D14.
13. Figure 3.37 "Completed Arguments for the SUMIFS Function" shows the defined arguments for the SUMIFS function. Values that meet all criteria defined in the function will be selected from the named range Cost_of_Purchase which is the range G4:G18. From the Investment Detail worksheet. Notice that the results for each argument of the function are shown along the right side of the Collapse Dialog buttons.

Figure 3.37 Completed Arguments for the SUMIFS Function

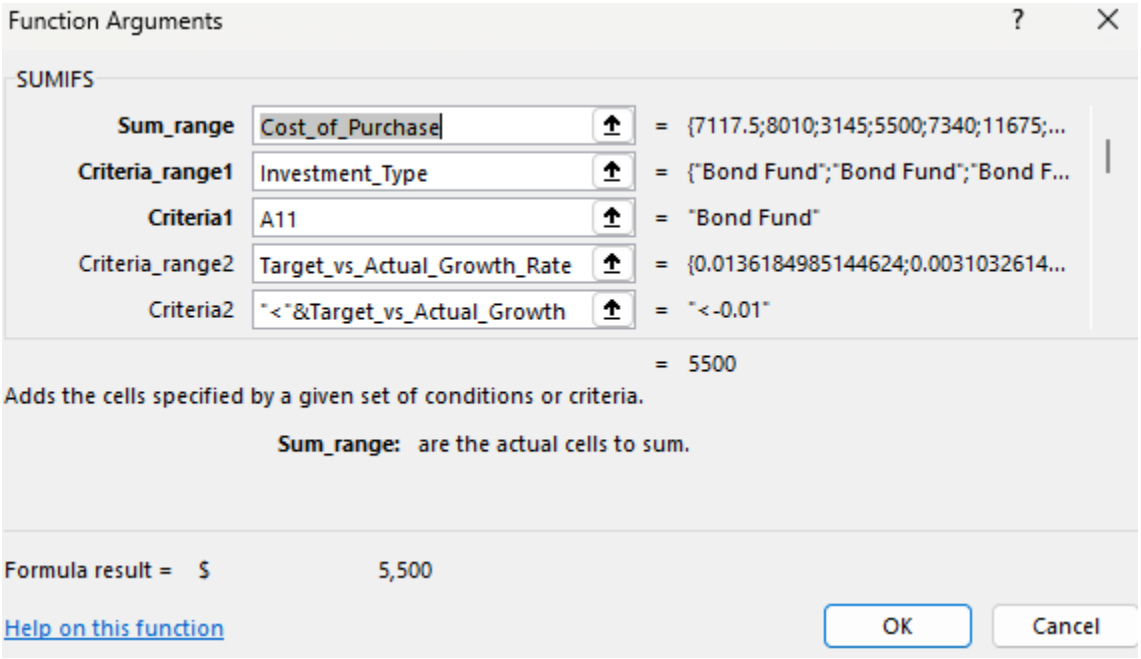
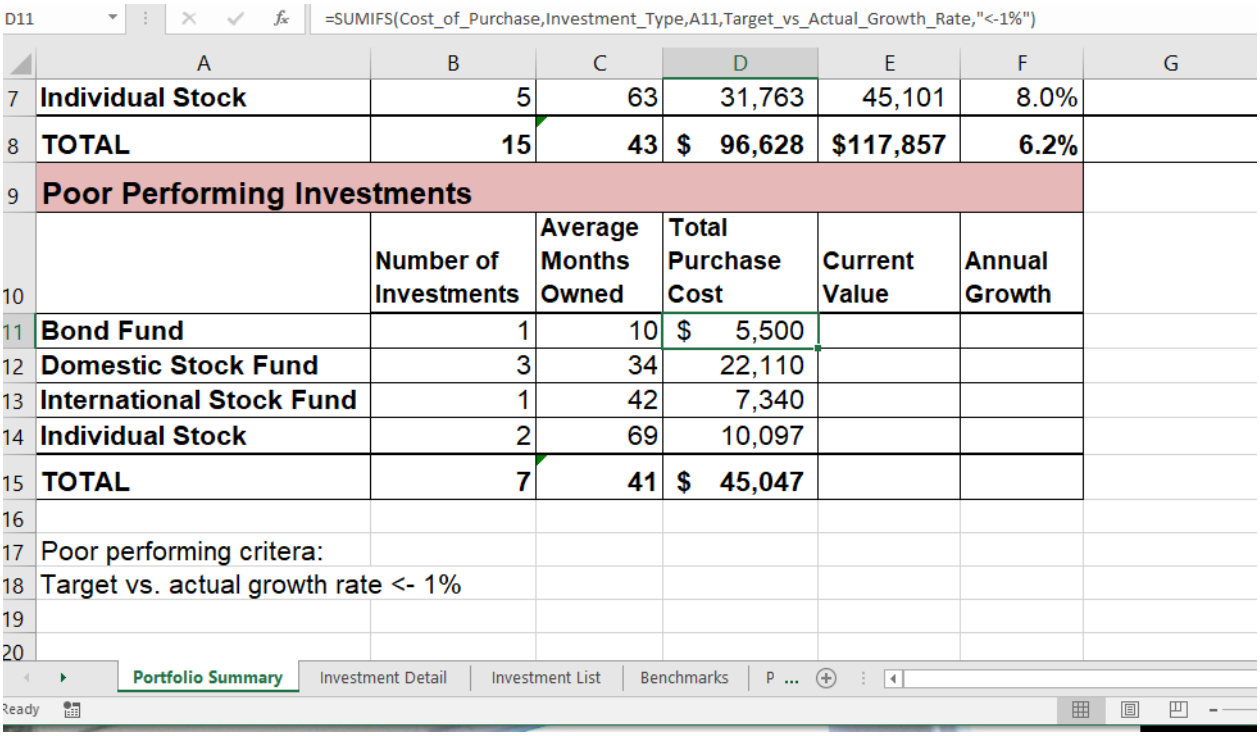


Figure 3.38 "SUMIFS Function Output for the Total Purchase Cost Column" shows the results of the SUMIFS function used to complete the Total Purchase Cost column. In total, over $45,000 was invested in funds and stocks that do not meet the performance goals of the portfolio.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.38 SUMIFS Function Output for the Total Purchase Cost Column



	A	B	C	D	E	F	G
7	**Individual Stock**	5	63	31,763	45,101	8.0%	
8	**TOTAL**	**15**	**43**	**$ 96,628**	**$117,857**	**6.2%**	
9	**Poor Performing Investments**						
10		**Number of Investments**	**Average Months Owned**	**Total Purchase Cost**	**Current Value**	**Annual Growth**	
11	**Bond Fund**	1	10	$ 5,500			
12	**Domestic Stock Fund**	3	34	22,110			
13	**International Stock Fund**	1	42	7,340			
14	**Individual Stock**	2	69	10,097			
15	**TOTAL**	**7**	**41**	**$ 45,047**			
16							
17	Poor performing critera:						
18	Target vs. actual growth rate <- 1%						
19							
20							

In addition to the Total Purchase Cost column, the SUMIFS function will also be used to complete the Current Value column for the Poor Performing Investments section on the **Portfolio Summary** worksheet. Notice that the Sum ranges change, but the criteria ranges, and the criteria remain the same as the other functions looking at the poor performance based on the criteria outlined in cell A18.

The following steps explain how to add the function to the worksheet to complete this column:

1. Click cell D11 on the **Portfolio Summary** worksheet.
2. Click the Formulas tab on the Ribbon.
3. From the Insert Function select SUMIFS. This will open the Function Arguments dialog box.
4. In the **Sum_range** argument on the Function Arguments dialog box use the Use in Formulas to select the named range **Current_Investment_Value**. Selected cells from this range will be summed based on the defined criteria in ensuing arguments.
5. Click in the **Criteria_range1** argument on the Function Arguments dialog and use the named range Investment_Type from the Use in Formulas on the Formulas ribbon. Once the **Criteria_range1** argument is defined, the **Criteria1** argument will appear in the Function Arguments dialog box.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

6. Press the TAB key on your keyboard to advance to the **Criteria1** argument and type the cell location **A11**. The criteria for the function will be the investment type that is entered into cell A11 on the **Portfolio Summary** worksheet. You will notice that as soon as you define this argument, the **Criteria_range2** argument will appear on the Function Arguments dialog box.
7. In the **Criteria_range2** argument on the Function Arguments dialog box use the named range Target_vs_Actual_Growth_Rate
8. Press the TAB key on your keyboard to advance to the **Criteria2**argument.
9. Type **"<"&Target_vs_Actual_Growth**. The second criterion for this function is a logical test that will identify cell locations where the value is less than −1%. For the purposes of this exercise, a poor performing investment is one that is below the target growth rate by more than 1%.
10. Click the OK button at the bottom of the Function Arguments dialog box.
11. Copy the function in cell D11 into the range D12:D14. Format the cells D12LD14 with a comma style and no decimal places.
12. Enter a regular SUM function in cell D15 on the **Portfolio Summary** worksheet that sums the values in the range D11:D14.

Figure 3.40 SUMIFS Function Output for the Current Value Column

E11 =SUMIFS(Current_Investment_Value,Investment_Type,A11,Target_vs_Actual_Growth_Rate,"<"&Target_vs_Actual_Growth)

	A	B	C	D	E	F	G	H
9	**Poor Performing Investments**							
10		**Number of Investments**	**Average Months Owned**	**Total Purchase Cost**	**Current Value**	**Annual Growth**		
11	**Bond Fund**	1	10	$ 5,500	$ 5,626			
12	**Domestic Stock Fund**	3	34	$ 22,110	$ 22,903			
13	**International Stock Fund**	1	42	$ 7,340	$ 5,958			
14	**Individual Stock**	2	69	$ 10,097	$ 13,990			
15	**TOTAL**	**7**	**41**	**$ 45,047**	**$ 48,478**			
16								
17	Poor Performing Criteria							
18	Target vs Acutal Growth <	-1%						

Now that the Total Purchase Cost and Current Value columns are completed for the Poor Performing Investments section on the **Portfolio Summary** worksheet, we can add a formula to show the annual growth rate by investment type. Since this is the same formula that was used in the Total Summary section of the **Portfolio Summary** worksheet, we can just copy and paste it. The following steps explain how to do this:

1. Copy the formula in cell F4 on the **Portfolio Summary** worksheet.
2. Highlight the range F11:F15 on the **Portfolio Summary** worksheet.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

3. Paste the formula using the Paste Formulas command.

Integrity Check – Error Message for Statistical IF Functions
If you receive an error message when attempting to enter a statistical IF function into a cell location, check to make sure any criteria using a comparison operator is enclosed in quotation marks. For example, if you are assessing a range of cells to see if the values are greater than or equal to zero, you must define the **Criteria** argument as follows: *">=0"*. If you do not use the quotation marks, Excel will not accept the function in the cell location and will display an error message.

Figure 3.41 "Completed Poor Performing Investments Section of the Portfolio Summary Worksheet" shows the completed Poor Performing Investments section on the **Portfolio Summary** worksheet. Notice that even though an investment is considered "poor performing" it does not mean that money is lost on the investment. As shown in the figure, only one investment in the International Stock Fund category is losing money, with an annual growth rate of −5.4%. However, the total annual growth rate for all investments in the Poor Performing section is 2.2% (see cell F15). This is less than half the growth rate for the overall portfolio, which is 6.2% (see cell F8). A final observation is that all the investments in the Domestic Stock Fund category are "poor performing." The same number of investments in the Total Summary section appears in the Poor Performing Investments section. This completes the **Portfolio Summary** worksheet except for one column. We will complete this column in the next section with a lookup function.

Figure 3.41 Completed Poor Performing Investments Section of the Portfolio Summary Worksheet

E11 =SUMIFS(Current_Investment_Value,Investment_Type,A11,Target_vs_Actual_Growth_Rate,"<-1%")

	A	B	C	D	E	F	G	
7	**Individual Stock**	5	63	31,763	45,101	8.0%		Dow
8	**TOTAL**	**15**	**43**	**$ 96,628**	**$117,857**	**6.2%**		
9	**Poor Performing Investments**							
10		**Number of Investments**	**Average Months Owned**	**Total Purchase Cost**	**Current Value**	**Annual Growth**		
11	**Bond Fund**	1	10	$ 5,500	$ 5,626	2.8%		
12	**Domestic Stock Fund**	3	34	22,110	22,903	1.3%		
13	**International Stock Fund**	1	42	7,340	5,958	-5.4%		
14	**Individual Stock**	2	69	10,097	13,990	6.8%		
15	**TOTAL**	**7**	**41**	**$ 45,047**	**$ 48,478**	**2.2%**		
16								
17	Poor performing critera:							
18	Target vs. actual growth rate <- 1%							
19								
20								

Portfolio Summary | Investment Detail | Investment List | Benchmarks | P ...

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Skill Refresher – SUMIFS

1. Type an equal sign (=).
2. Type the function name **SUMIFS** followed by an open parenthesis (**(**)
3. Define the **Sum_range** argument with a range of cells that contain values to be summed.
4. Type a comma.
5. Define the **Criteria_range1** argument with a range of cells that will be evaluated based on the criteria used to define the **Criteria1** argument.
6. Type a comma.
7. Define the **Criteria1** argument with a cell location, number, text, or logical test. Text and logical tests must be enclosed in quotation marks.
8. Repeat steps 4, 5, 6, and 7 to define as many pairs of criteria arguments as needed.
9. Type a closing parenthesis (**)**)
10. . Press the ENTER key on your keyboard.

Key Takeaways

- The COUNTIF, SUMIF, and AVERAGEIF functions can select specific cell locations from a range to compute an output using one criteria argument.
- The COUNTIFS, SUMIFS, and AVERAGEIFS functions can select specific cell locations from a range to compute an output using multiple sets of criteria arguments.
- When using the AVERAGEIF and SUMIF functions, the row numbers used in the ranges to define the **Range** argument and the **Average_range** or **Sum_range** arguments must be identical.
- The benefit of using statistical functions when creating a summary worksheet is that if rows of data are added to the detail worksheet, the new data will automatically be included in the function output.
- When using statistical IF functions, the logical test used to define a criteria argument must be enclosed in quotation marks

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

EXERCISES

1. Consider the following SUMIF function: =SUMIF(B2:B10,A1,E2:E20). What cell range will be used to compute the output for the function?

   a. E2:E10
   b. B2:B10
   c. E2:E20
   d. B2:B20

2. Which of the following is true with respect to the COUNTIF function?

   a. It can only be used to sum selected cells from a range using one set of defined criteria.
   b. It can be used to count both numeric and nonnumeric values in selected cells from a range using one set of defined criteria.
   c. It can be used to count only numeric values in selected cells from a range given one set of defined criteria.
   d. It can be used to count only numeric values in selected cells from a range using multiple sets of defined criteria.

3. If you wanted to calculate the average of the values contained in the range B5:B20 based on any values in the range E5:E20 with a value greater than 5, which of the following functions would provide an accurate result?

   a. =COUNTIF(B5:B20,>5,E5:E20)
   b. =AVERAGEIF(B5:B20,>5,E5:E20)
   c. =AVERAGEIF(E5:E20,>5,B5:B20)
   d. =AVERAGEIF(E5:E20,">5",B5:B20)

4. Suppose you wanted to sum the values in the range C3:C15 where the values in B3:B15 are equal to the word *Bond* and where the values in the range D3:D15 are greater than 3%. Which of the following functions would provide an accurate result?

   a. =SUMIFS(C3:C15,B3:B15,"Bond",D3:D15,">3%")
   b. =SUMIFS(B3:B15,"Bond",D3:D15,">.03",C3:C15)
   c. =SUMIFS($C$3:$C$15,$B$3:$B$15,"Bond",$D$3:$D$15,>3%)
   d. =SUMIFS($B$3:$B$15,=Bond,$D$3:$D$15,>.03,$C$3:$C$1)

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

3.3 Data Validation

LEARNING OBJECTIVES
1. Learn the types of data validation.
2. Use the UNIQUE function to extract a data validation list
3. Use data validation to control data entry into fields..

Some of the documents you will prepare for your business will be what are called templates. A template is simply a pre-made form that others can use to complete the work for a company. A common template would be a sales invoice form. On the invoice, you would want your salespeople to be able to select from a drop down of products and have the resulting selection fill in the price per unit and the product description. The salespeople could enter the number of units but could not change the description fields or the price fields. We will look at the use of data validation to help limit what can be entered into fields. For this conversation, we will describe a cell as a field.

When a data validation rule is created, you can specify what kind of data is allowed. You can also prohibit the entry of anything other than the allowed data, you can warn that the data is not what is expected, or you can just let the data be entered with an explanation of what is expected to be in the field.

Table 3.71 Allowable options for data validation.

Any value	This is the default when no data validation is applied
Whole number	Limit entries to whole numbers (no decimal places allowed.) a range of acceptable whole numbers (integers) can be specified.
Decimal	Any type of number, including percentages, a range of acceptable values can be specified.
List	Amy value in a range or entered in the Data Validation dialog box separated by commas
Date	Limited to dates only; you can specify acceptable date ranges
Time	Times only; you can specify acceptable time ranges
Text length	Text limited to a specific number of characters – for instance a phone number would be considered text and be a specific length.
Custom	Values based on the results of a logical formula.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

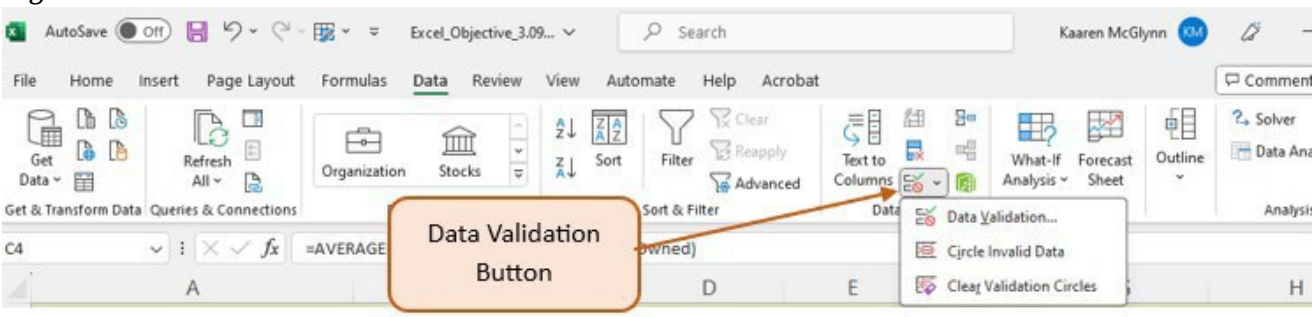
Data Validation List – Created Source

Follow-along file: Continue with Excel Objective 3.00. (Use file Excel Objective 3.14 if starting here.)

We will use data validation to create a buy/sell form for the various investments. The steps we will use to do this are:

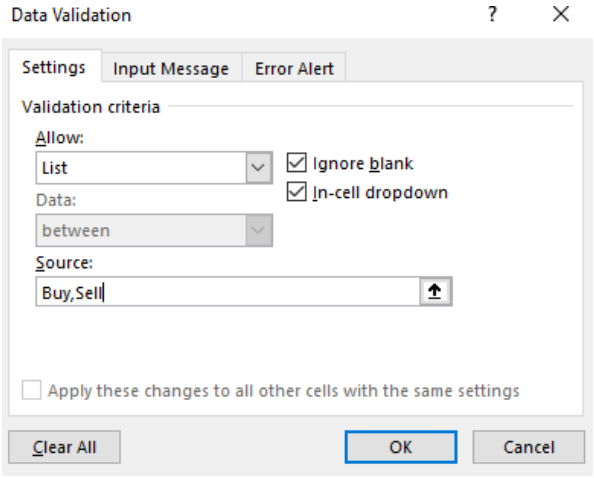
18. Activate the Buy/Sell worksheet. We use a different data validation rule in each of the cells in the range B3:B7.
19. In cell B3, we will create a text data validation rule that describes the type of transaction this will be. Click on cell B3. From the Data Tools section of the Data ribbon, use the drop-down button to select Data Validation.

Figure 3.40b Data Validation Button



20. In the Data Validation dialog box, use the drop-down button next to the Allow: box and choose List.
21. In the Source field, type Buy, Sell. Make sure the two words are separated by a comma.

Figure 3.40c Data Validation Dialog Box

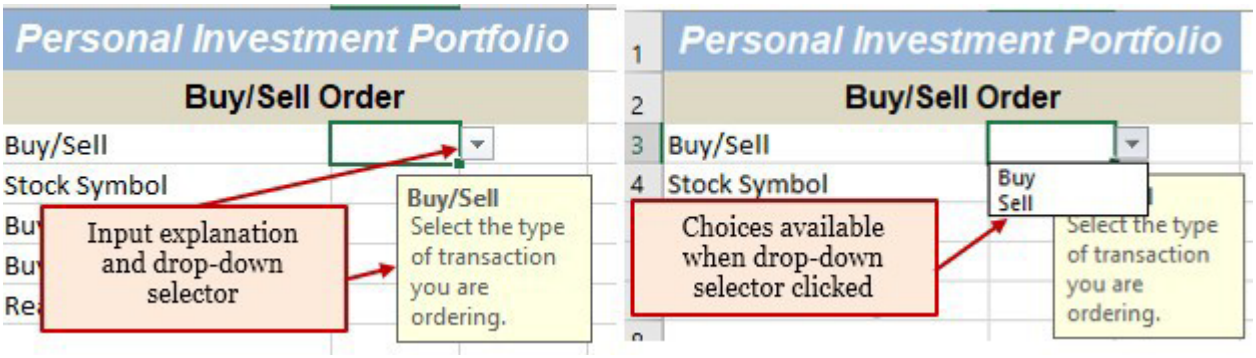


22. Click on the Input Message tab. In the tile type Buy/Sell.
23. In the Input message field type: **Select the buy or sell transaction you are ordering.**

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

24. Click the Ok button.
25. Note that cell B3 now has a drop-down arrow next to the cell. When the cell is active, the input message you just entered will show below the cell. When clicked, the drop down will show the choices available for what can go in the cell.

Figure 3.40c Data Validation Results in the Cell



Data Validation List Named Range

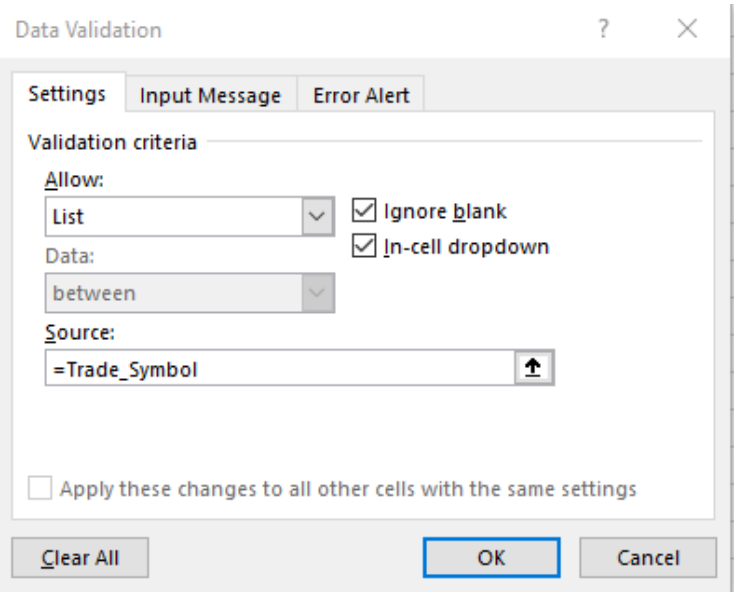
Data validation can also be used to create a list using a range of cells. If you are going to use a range of cells there are two rules you must follow:

- The range of cells must be on the same worksheet as the data validation cell, OR
- Use a named range of cells from a different worksheet. The named range must be one column or one row of data only.

The steps we will follow to create a drop-down list for the investment symbols are:

1. Select Sell from the drop-down list.
2. Cell B4 will contain the stock symbol for the investment to be traded. We will use a named range to create the data validation list for this cell. Go to the Investment List worksheet. Highlight the range B3:B22 From the Defined Names section of the Formula Ribbon, select Define Name.
3. In the Define Name section, type in Trade_Symbol. (Don't forget to use the underscore between the words Trade and Symbol. Defined names cannot contain spaces.)
4. Go back to the Buy Sell Order worksheet and make cell B4 active.
5. From the Data ribbon click the data validation drop-down list and select List in the Allow box.
6. Click in the Source box. From the Defined Names section of the Formula ribbon, select Use in Formula. Scroll down the list of names until you see Trade_Symbol. Click on Trade_Symbol. (Excel will insert an = sign before the named range.)

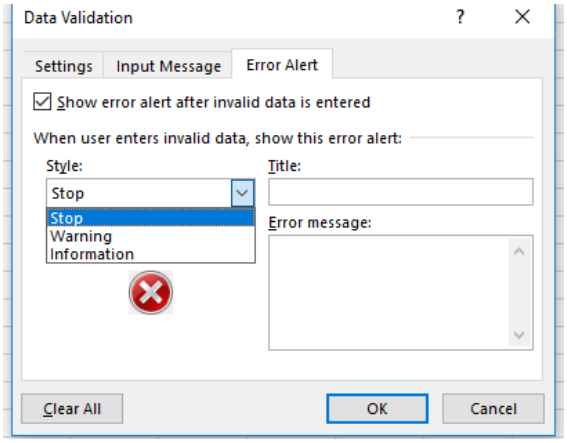
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International



7. Click on the Input Message and type: Select the investment symbol from the list.

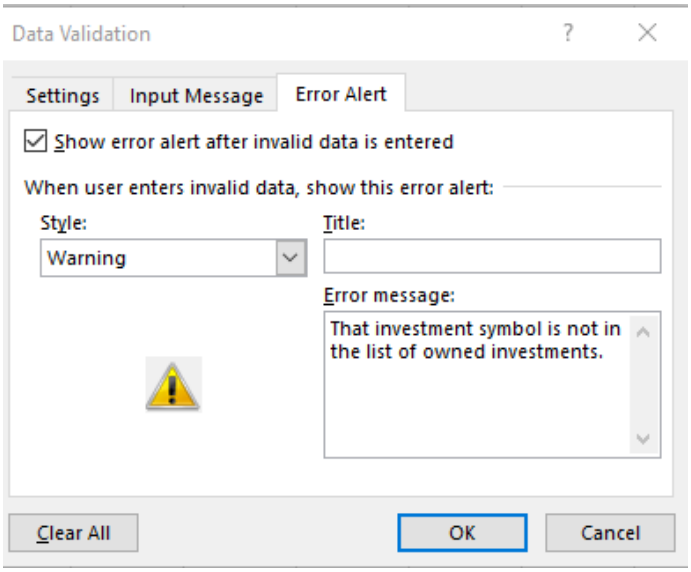
Integrity Check - Data Validation Input Message
Every cell that has data validation should have an input message to alert the user as to what should be entered into the cell and the types of data the cell will accept.

8. Click on the Error Alert.
9. There are three options for the error alert dialog box. **Stop**: the data that is being input must match the data allowed. **Alert:** the data does not match, and the user must choose to proceed or not, and **Information:** the user will be alerted that the data does not match, but no choice will be given before the data can be entered.



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

10. Because this is a buy/sell situation, we may be buying an investment that is not already in the portfolio. We will select a Warning message that will alert the user that the symbol is not in the list of currently owned investments.
11. On the Error message box type: That investment symbol is not in the list of owned investments.
12. Click OK.



13. Try typing a symbol into B4 that is not in the list. You will get an error message, but you will also get the choice to proceed or not. Choose to not proceed. Delete the characters you entered from B4 and select VFICX from the drop-down list.
14. Select cells A3:C3. Right click and Insert. Shift cells down, and then click OK.

Data Validation – Date

Next, we will validate the transaction date to ensure the date of the order will be today or later. The steps we will use are:

1. Insert a row at A3 by highlighting A3: C3. Then use the Ctrl and + keys to insert cells. Select Shift Cells Down.
2. In Cell A3 type: Today's Date:
3. In cell B3 type the formula =TODAY() *Note: this will insert a dynamic formula that will change each time the workbook is opened to reflect the current date.*
4. Activate cell B6. Open the data validation dialog box and select Date from the list of options.

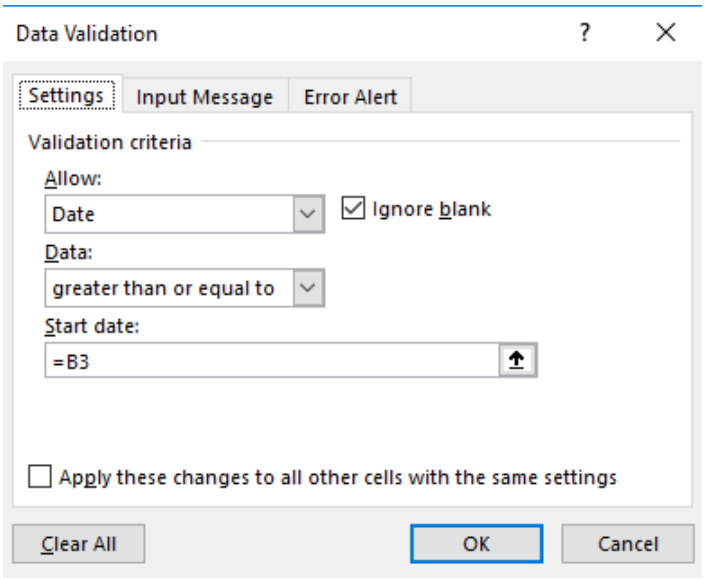
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

5. New Data choices will be given:

Between	Enter a start and end date
Not between	The date entered cannot be between the dates indicated.
Equal to	Must be the exact date entered.
Not equal to	Can be any date but the date designated.
Greater than	Must be after the specified date.
Less than	Must be before the date entered.
Greater than or equal to	Can be equal to or after the designated date
Less than or equal to	Must be the designated date or before.

6. Select greater than or equal to. We can't tell the broker to sell something yesterday-only today or later.

7. Tab to the Start date box. Click on cell B3 as the start date. This will dynamically link your valid date to the TODAY() function.



8. Click on the input message tab and in the Input message box type: Trade date must be today or after today's date.

9. Click the Error Alert tab, select Stop as the alert. In the Error message type: Date entered is before today's date. Note: your error message should always inform the user why the error has occurred.

10. Put yesterday's date into the cell. Excel will stop you and tell you why the entry is invalid.

11. Enter tomorrow's date into B6.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

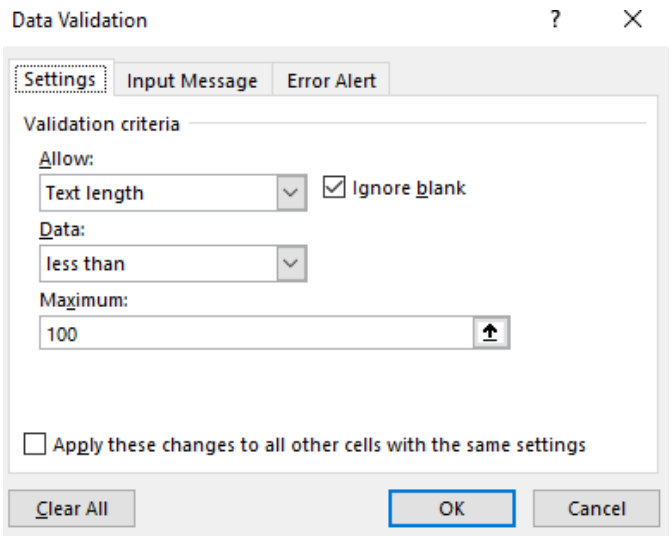
Data Validation - Number

1. Click on cell B7. In this cell, the price will be entered. We will control the entry to be a number with 0 decimal places.
2. From the data validation settings dialog box, select Whole Number.
3. In the Data box select greater than
4. In the Minimum box type in 0.
5. In the Input Message tab type: Enter the buy/sell price in whole numbers. We won't have an error message for this cell.
6. On the Home ribbon format cell B7 for $ with 0 decimal places.

Data Validation – Text

The last validation we will add to our worksheet is text validation to limit the number of characters the user can add when explaining why the investment is being bought or sold. The steps we will use to do that are:

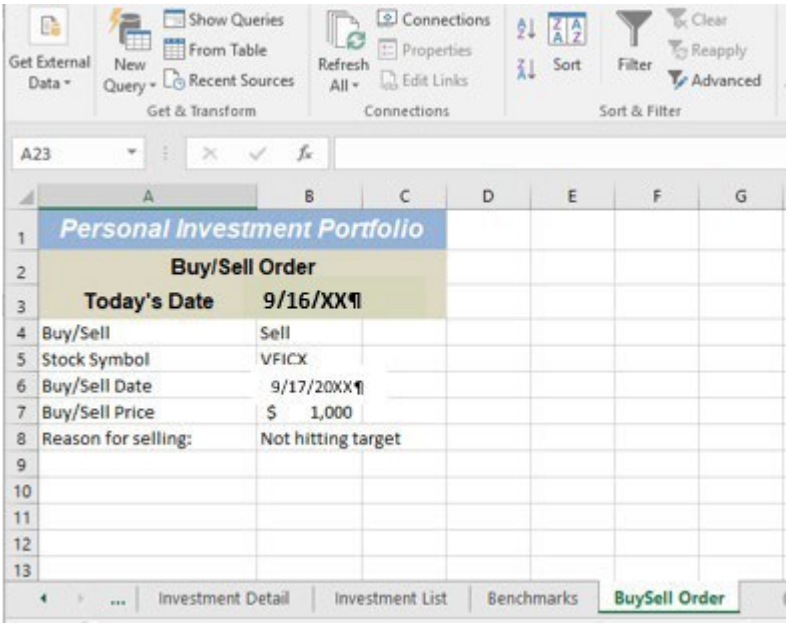
1. Make cell B8 active. Because we are looking for a buy/sell reason, we will make cell B8 accept text input only.
2. From the data validation Settings Allow drop-down, select Text length.
3. In the Data box select less than.
4. In the Maximum box type: 100. *Note: this will limit the number of characters to less than 100.*



5. For the input message type: Enter reason for buying/selling.
6. Do not put in an error alert.
7. In cell B8 type: Not hitting target.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.40d Completed Data Validation Worksheet

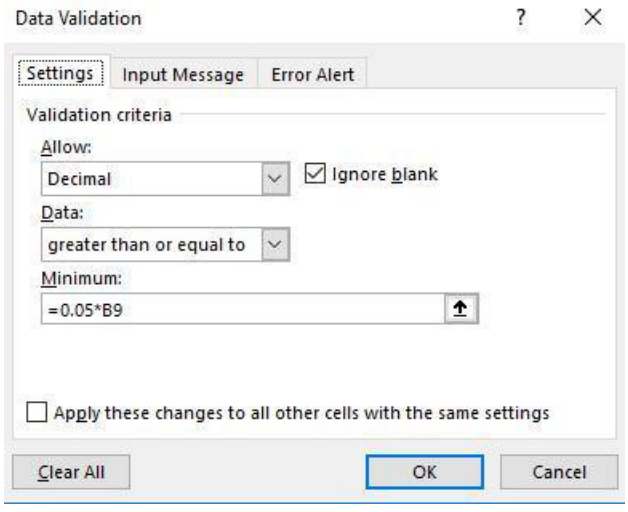


Data Validation UNIQUE List

Covered in Chapter 6. Dynamic Array Functions

Data Validation – Calculated Field

While not using a specific example in this worksheet, we can create data validation based on a calculation. For example: We can have the data validation test to see if the value entered is at least 5% of a value in another cell. The calculation must begin with an =.



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Skill Refresher – Data Validation
1. Activate the cell you want to validate. 2. From the Data Tools section of the Data ribbon, select Data Validation 3. Select what type of data will be validated from the drop-down list. 4. Create the rules for the validation. 5. Create the Input message to inform the user about what to put in the cell. 6. Determine if an Error message and action is required for the cell. If so, select either Stop, Alert, or Information. 7. Enter Error message if selected.

Key Takeaways
• Always include an input message for cells containing data validation. • Protect the types of information that can be entered into a cell by using data validation. • A data validation list can help eliminate spelling and data input errors.

3.4 XLOOKUP Function

LEARNING OBJECTIVES
1. Use XLOOKUP to search and display contents of a cell or cells with the option of returning an error message. Legacy Functions: (Covered at the end of the text.) 2. Use the VLOOKUP function to search and display the contents of a cell location for data that is organized in columns. 3. Use the HLOOKUP function to search and display the contents of a cell location for data that is organized in rows.

The final section of this chapter addresses the XLOOKUP function. Lookup functions are typically used to search for, and display data located in other worksheets or workbooks. The lookup function we will use in our example of the personal investment portfolio is the XLOOKUP function.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

The XLOOKUP Function

XLOOUP was introduced in Excel 365 and is not available in legacy Excel applications. This landmark release adds support for dynamic arrays. Unless backward compatibility with legacy Excel version (Excel 2019 and earlier) is necessary, XLOOKUP should always be used for new work.

The syntax for XLOOKUP is:

=XLOOKUP(lookup_value, lookup_array, return_array. [not_found], [match_mode], [search_mode])

The first three arguments, (those without square brackets), are required and the last three, (those inside square brackets), are optional.

Table 3.10 Arguments for the XLOOKUP Function

Argument	Definition
lookup_value	This argument is typically defined with a cell location, number, or text. Text data must be enclosed in quotation marks for this argument. The function will search for the criteria in the **lookup_array** argument. For example, if the word ***Hat*** is used to define this argument, the function will always search for the word ***Hat*** in the table_array. When the value is found XLOOKUP remembers that Hat is in the second element of the table_array.
lookup_array	A range of cells that contains the data you wish the function to search though (lookup_value) and display. This cell range *must* contain the criteria used to define the **lookup_value.**
return_array	A range of cells that contains the data you wish the function to return when a match is found for the lookup_value. This cell range *must* be laid out in the same order as the lookup_array. See image below.
[not_found]	Not found is the value to be returned when no match is found. The square bracket denotes it is not mandatory for the function to work. If text will be used a return message, the text must be enclosed in quotes. " "
[match_mode]	XLOOKUP is able to return the next smallest item or next largest item when doing an inexact match. It can also be used to do a wildcard character search.

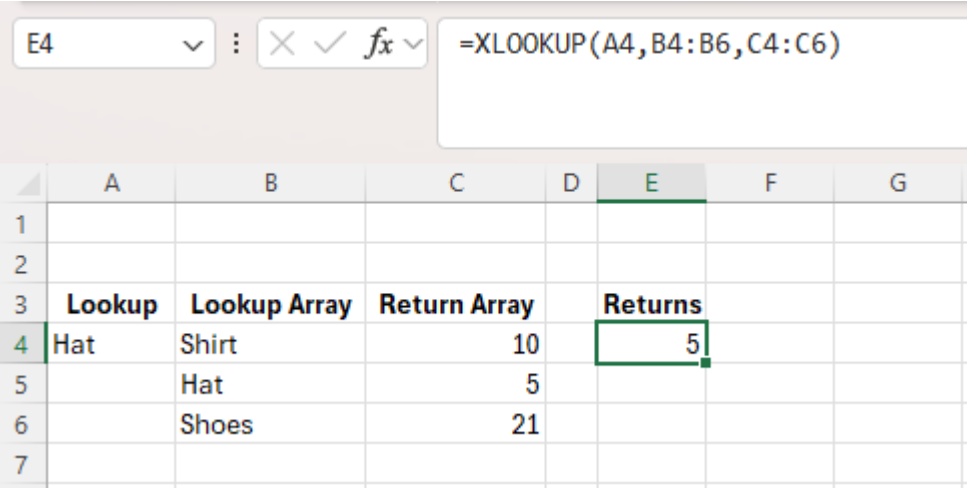
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Simple XLOOKUP

XLOOKUP can return a single value or an array of values. Here's how it works

Follow-along file: Continue with XLOOKUP Introduction

Figure 3.41 XLOOKUP Function for a single return value



	A	B	C	D	E	F	G
1							
2							
3	**Lookup**	**Lookup Array**	**Return Array**		**Returns**		
4	Hat	Shirt	10		5		
5		Hat	5				
6		Shoes	21				
7							

XLOOKUP requires a lookup value(A4) and two arrays; the lookup_array (B4:B6) and the return_array (C4C6). In this example the lookup value in B4 is "Hat".

The lookup_array in cells B4:B6 contains {"Shirt","Hat","Shoes"}

And the return_array in cells C4:C6 contains {10,5,21}

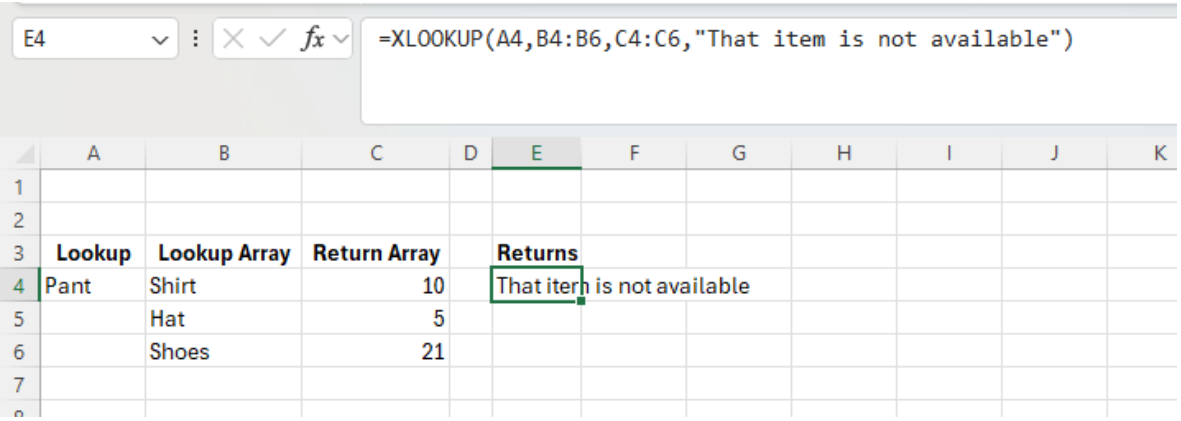
XLOOKUP searches for the lookup value *Hat* in the lookup_array. When the value is found, XLOOKUP remembers that *Hat* is the second position element in the lookup_array. XLOOKUP then fetches the value contained in the second element in the return_array (5) and returns it to the cell containing the function (cell E4).

XLOOKUP custom error messages

If XLOOKUP is unable to find a matching value, a custom error message can be set up in the not_found message.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

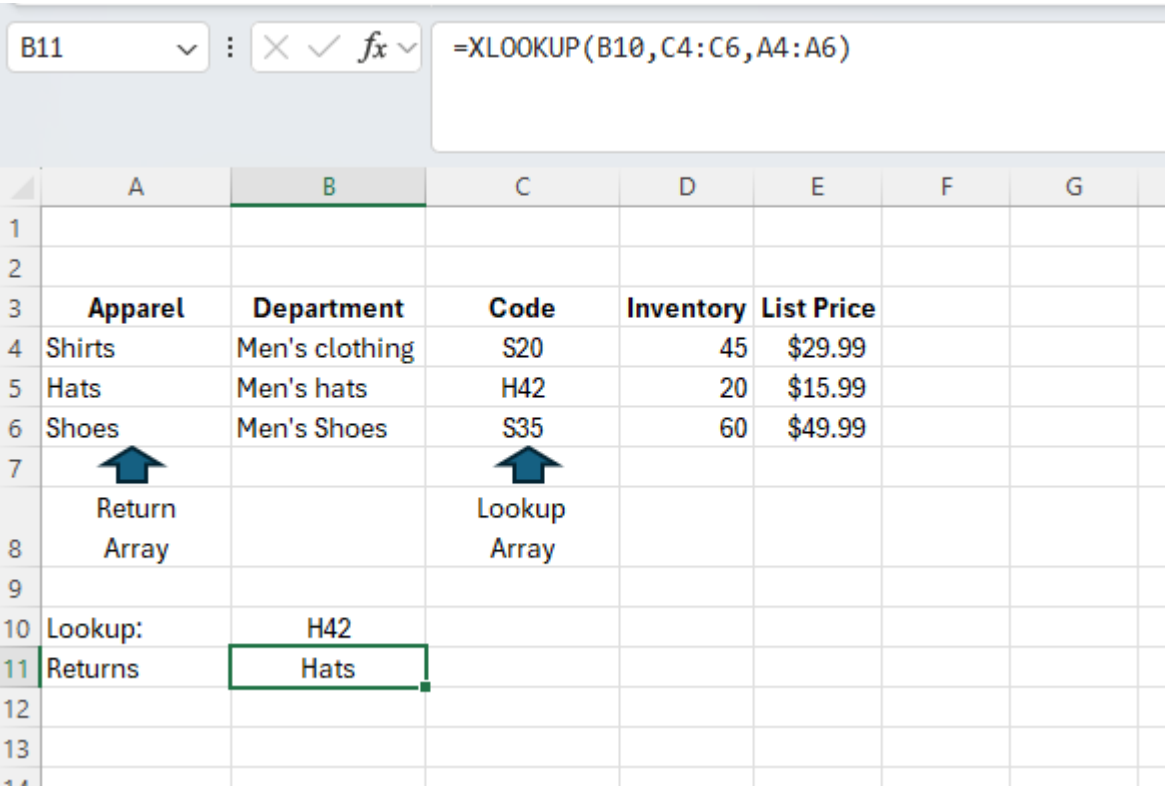
Figure 3.42 XLOOKUP Function returning a custom error message



Any column or row can be used for the lookup and return arrays. However, the lookup array columns or rows must contain the return values in the same order as the lookup values in the arrays and the same number of cells in each array.

For example:

Figure 3.43 XLOOKUP Function arrays

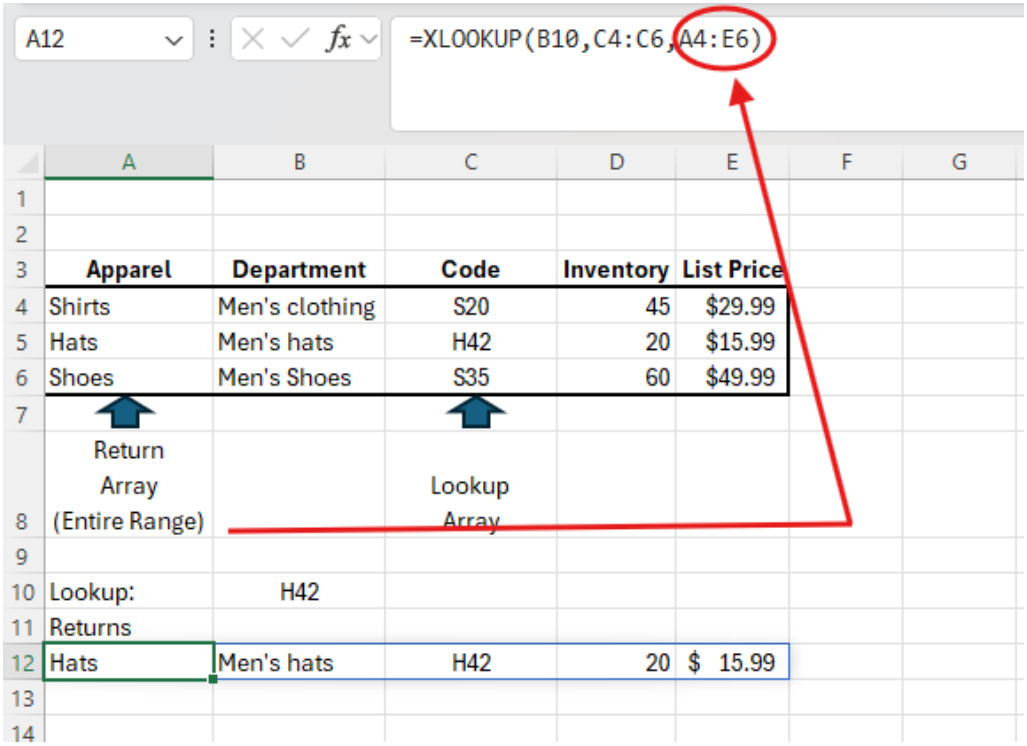


XLOOKUP can return multiple values

While legacy VLOOKUP and HLOOKUP function are limited to returning only one value, XLOOKUP can return more than one value.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

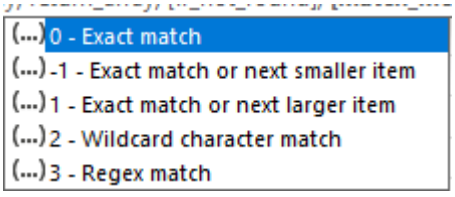
Figure 3.44 XLOOKUP Function for multiple return values



In this example the XLOOKUP function returns an array of five values because the return_array was defined as the entire range A4:E6.

XLOOKUP for relative or inexact searches

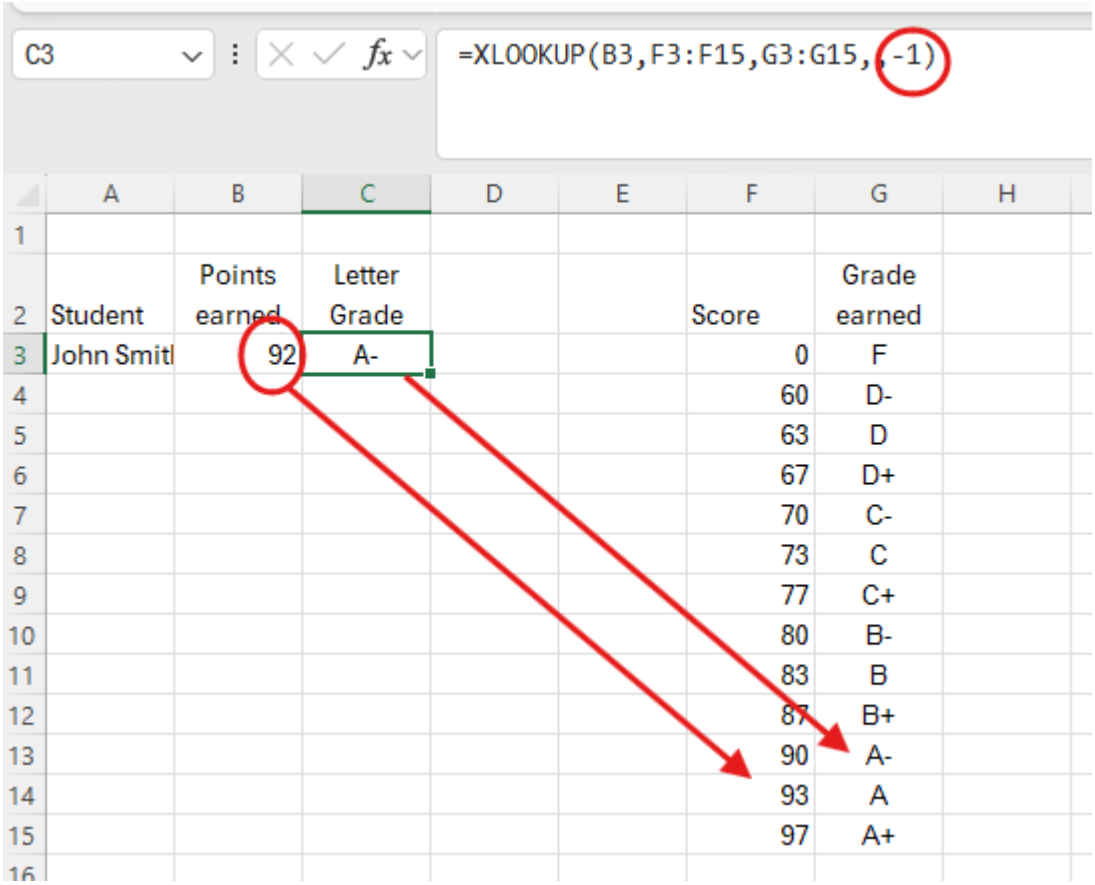
XLOOKUP defaults to an exact match unless an argument is added to instruct it to do otherwise. For a relative or inexact search, the function is able to return the next smallest item or the next largest item or use a wildcard in the type of match. The relative match is used when dealing with volume, grade ranges, shipping charges,disconts, etc., The relative match is defined in the fifth argument of the XLOOKUP function:


(...) 0 - Exact match
(...) -1 - Exact match or next smaller item
(...) 1 - Exact match or next larger item
(...) 2 - Wildcard character match
(...) 3 - Regex match

For example: When putting together grades for a class, the goal is to match the letter grade to the points earned. As XLOOKUP searches for the letter grade to match the points earned, the result desired would be for the next lower grade than the next higher grade. In the example below, the student earned a 92 which is an A-. To obtain an A the student would need 93 points as a minimum.

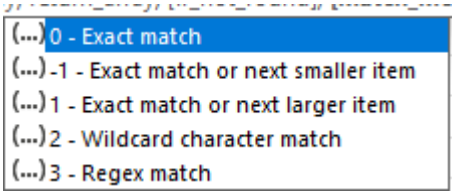
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.45 XLOOKUP Function for a relative/inexact return value



XLOOKUP using wildcards

Wildcards are search strings that can include the * and? Wildcard symbols. The XLOOKUP function's match_mode argument enables the definition of a wildcard search. The wildcard can be any character designated in the 5th argument of the XLOOKUP function. For example: *,?,! could be used as a wildcard character match.


0 - Exact match
-1 - Exact match or next smaller item
1 - Exact match or next larger item
2 - Wildcard character match
3 - Regex match

XLOOKUP horizontal and vertical lookups

XLOOKUP provides both vertical (replaces VLOOKUP) and horizontal (replaces HLOOKUP) functions and can combine the horizontal arrays in the same function.

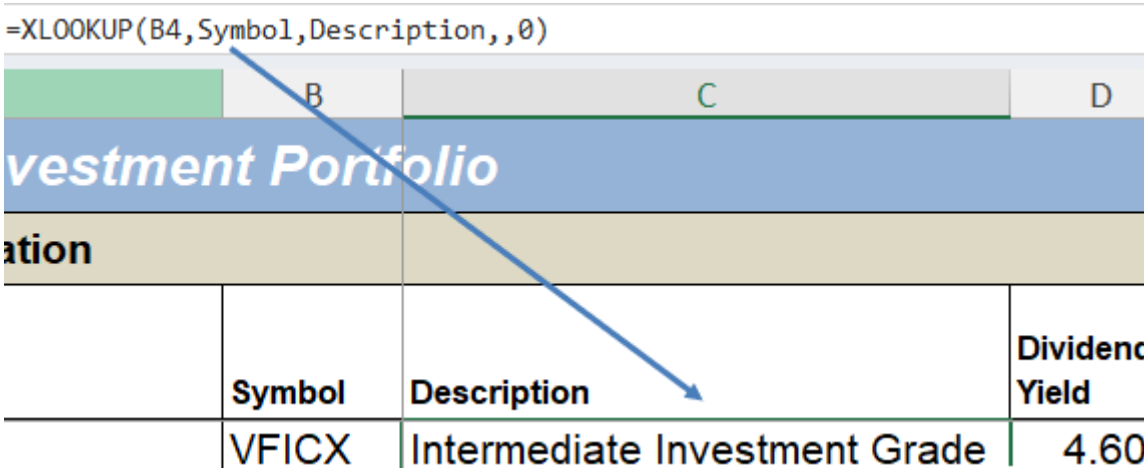
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Follow-along file: Continue with Excel Objective 3.00. (Use file Excel Objective 3.15 if starting here.)

You may have noticed that on the **Investment Detail** worksheet, the Description column is blank. Descriptions for several investments are included in the workbook in the **Investment List** worksheet as shown in Figure 3.42 "Investment List Worksheet". The XLOOKUP function will be used to search for a specific symbol in Column A of the Investment List worksheet and display the description for that symbol located in Column B. It is important to note that once the lookup and return arrays have been defined, the XLOOKUP can return any value within that array that matches the lookup value. The default is an exact match no matter the placement in the arrays.

1. On the Investment List worksheet select the rangeA2:B23 and use the Create from Selection on the Formula ribbon to create the needed arrays. Make sure that top row is selected and deselect left column if it is checked.
2. On the Investment Detail worksheet, click on cell C4. We will use XLOOKUP to find the investment description that matches the symbol in the B column.
3. Type: =XLOOKUP(
4. Click on the lookup value is the Symbol in B4. Type a comma.
5. The lookup array for the symbol will come from the named range on the Investment List worksheet -Symbol. Type a comma.
6. The return array will be Description from the named range on the investment list worksheet. Type in two commas. We need to tell the function that we need an exact match
7. Type a 0. Hit enter. Excel will close the function for us and return the description for the VFICX investment.

Figure 3.46 XLOOKUP Function for a single return value



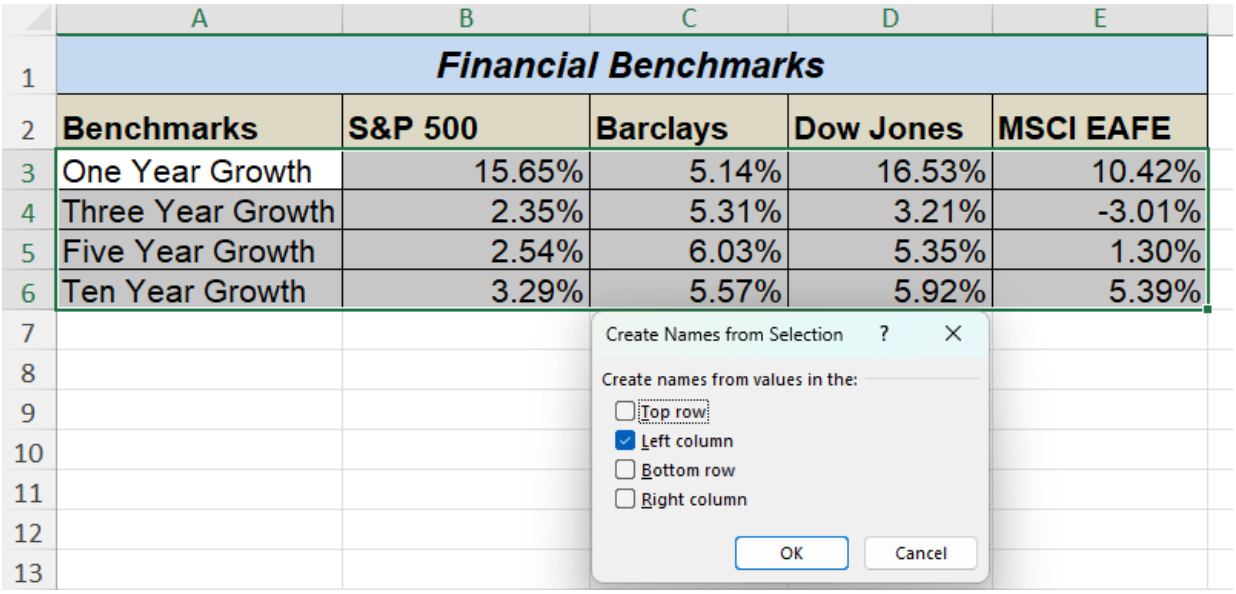
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Let's finish up the workbook by completing the last piece of missing information on the Portfolio Summary worksheet.

The XLOOKUP function will be used on the **Portfolio Summary** worksheet to display the benchmark growth rates in the range G4:G7. A benchmark is a value that can be used as a standard point of comparison. The **Benchmarks** worksheet contains growth rates at different year intervals for the benchmarks that will be used to compare the performance for each investment type (see Figure 3.45 "Benchmarks Worksheet"). For the purposes of this workbook, we will be comparing the growth rates for each investment type to the 5-year average growth rate for the benchmarks categories listed in the range H4:H7. The following steps explain how to construct the XLOOKUP function to display the 5-year benchmark values in the **Portfolio Summary** worksheet:

Go to the Benchmarks worksheet by clicking on the Benchmarks tab.

1. We will name the Benchmarks range to be used in the XLOOKUP function. The range we will name is B2:E2. The top row contains the look up values the function will use to find a match. The remaining rows will be the results returned once a match is found.
2. Highlight A3:E6 and use the Create from Selection option on the Formula ribbon. In this instance you will want the left column selected.

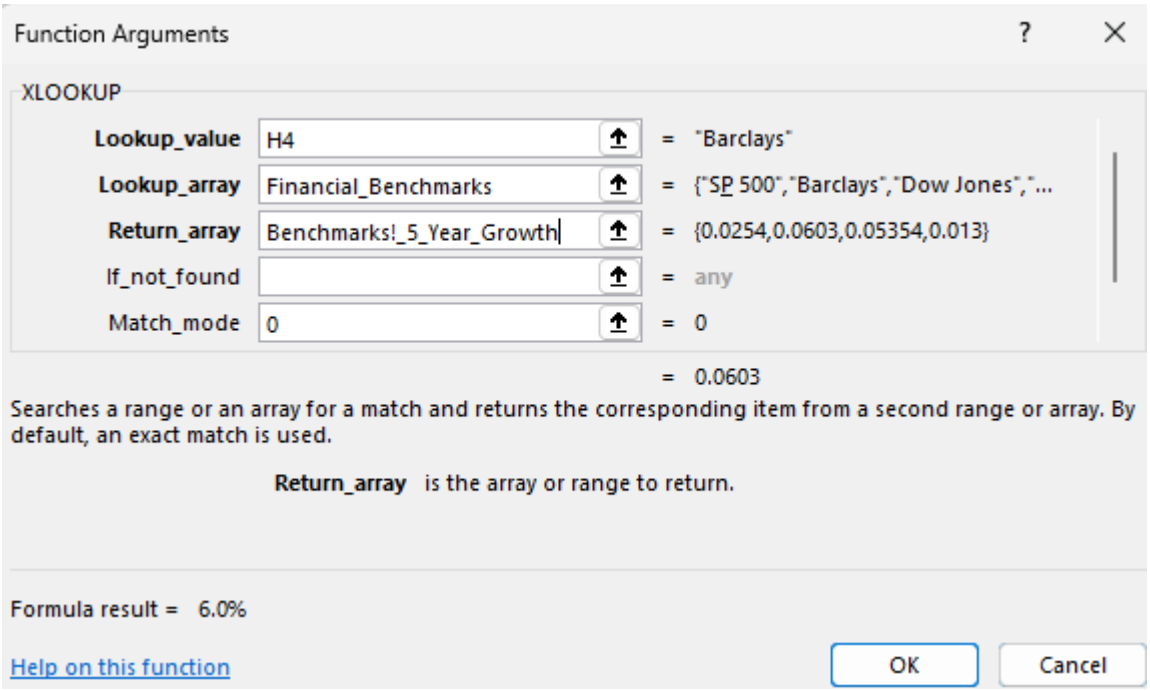


3. Click cell G4 in the Portfolio Summary worksheet.
4. Click the Formulas tab on the Ribbon.
5. Click the Lookup & Reference button in the Function Library group of commands.
6. Select the XLOOKUP function from the list of functions. This will open the Function Arguments dialog box for the XLOOKUP function.
7. Click in the **Lookup_value** argument on the Function Arguments dialog box.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

8. Click cell H4. The description in cell H4 will be the lookup value that will be searched in the first row of the range defined for the **Lookup_array** argument.
9. Click in the **Lookup_array** argument on the Function Arguments dialog box.
10. From the Formulas ribbon, Use in Formula, select the named range Benchmarks.
11. Press the TAB key on your keyboard to advance to the **Return_array** argument and type the number from the Use in formula drop down, select Five_Year_Growth. It will display in the box as Benchmarks!Five_Year_Growth
12. Tab through the If_not_found box.
13. In the Match_mode box type 0.
14. Click the OK button at the bottom of the Function Arguments dialog box.
15. Copy the XLOOKUP function in cell G4 and paste it into the range G5:G7 using the Paste Formulas command.

Figure 3.48 "Completed Function Arguments Dialog Box for the XLOOKUP Function" shows the completed Function Arguments dialog box for the XLOOKUP function.



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

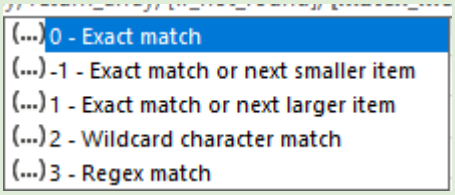
Integrity Check - #N/A and #REF! Errors with Lookup Functions

If you receive the **#N/A** error code when using the XLOOKUP function, it indicates that Excel cannot find the lookup value in the table array range. Check that the lookup value exists in the lookup array argument. You may also see this error code if you copy and paste the function and forget to put an absolute reference on the range used to define the **lookup_array** argument.

Skill Refresher -XLOOKUP

1. Type an equal sign (=).
2. Type the function name XLOOKUP followed by an open parenthesis (().
3. Define the Lookup_value argument with a cell location, number, or text that will be searched in another workbook or worksheet. Text must be placed in quotation marks.
4. Type a comma.
5. Define the lookup_array argument with a range of cells that contain the lookup value in the first column along with data that is to be displayed or used by the function.

   Optional Arguments:
6. Type a comma.
7. Define message to be returned if the value is not found.
8. Type a comma.
9. Define the type of search to be conducted.


(...) 0 - Exact match
(...) -1 - Exact match or next smaller item
(...) 1 - Exact match or next larger item
(...) 2 - Wildcard character match
(...) 3 - Regex match

10. Type a closing parenthesis).
11. Press the ENTER key on your keyboard

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

IFERROR

Follow-along file: Continue with Excel Objective 3.00. (Use file Excel Objective 3.16 if starting here.)

Suppose your spreadsheet formulas have errors that you anticipate and don't need to correct, but you want to improve the display of your results. For example, when creating an invoice template, you will want the invoice to look blank, but have the functions set up, so that when data is entered into the invoice, the invoice will correctly calculate the amount due. You will want the errors in the functions to not show as errors and not keep Excel from being able to perform the mathematical operations necessary in the invoice.

There are many reasons why formulas can return errors. For example, division by 0 is not allowed, and if you enter the formula =1/0, Excel returns #DIV/0. Error values include #DIV/0! #N/A, #NAME?, #NULL!, #NUM!, #REF!, and #VALUE!.

Error Value	Description of Error
#DIV/0!	The formula or function contains a number divided by zero.
#NAME?	Excel doesn't recognize text in the formula or function, such as when the function name is misspelled.
#NULL!	A formula or function requires two cell ranges to intersect, but they don't.
#NUM!	Invalid numbers are used in a formula or function, such as text entered in a function that requires a number.
#REF!	A cell reference used in a formula or function is no longer valid which can occur when a cell used by the function was deleted from the worksheet.
#VALUE	The wrong type of argument is used in a function or formula, which can occur when you supply a range of values to a function that requires a single value.

There are several ways you can hide error messages you are expecting in a worksheet. You can hide error values by converting them to a number such as 0 and then applying a conditional format that hides the value, or by having what looks like a blank cell returned when an error is encountered.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Create an example error

1. Open a blank workbook or create a new worksheet.
2. Enter **3** in cell B1, enter **0** in cell C1, and in cell A1, enter the formula **=B1/C1**. The #DIV/0! error appears in cell A1.
3. Select A1, and press F2 to edit the formula.
4. After the equal sign (=), type **IFERROR** followed by an opening parenthesis. **IFERROR(**
5. Move the cursor to the end of the formula.
6. Type **,0)** – that is, a comma followed by a zero and a closing parenthesis. The formula **=B1/C1** becomes **=IFERROR(B1/C1,0)**.
7. Press Enter to complete the formula. The contents of the cell should now display 0 instead of the #DIV! error.

Apply the conditional format

1. Select the cell that contains the error, and on the **Home** tab, click **Conditional Formatting**.
2. Click **New Rule**.
3. In the **New Formatting Rule** dialog box, click **Format only cells that contain**.
4. Under **Format only cells with**, make sure **Cell Value** appears in the first list box, **equal to** appears in the second list box, and then type 0 in the text box to the right.
5. Click the **Format** button.
6. Click the **Number** tab and then, under **Category**, click **Custom**.
7. In the **Type** box, enter **;;;** (three semicolons), and then click **OK**. Click **OK** again. The 0 in the cell disappears. This happens because the **;;;** custom format causes any numbers in a cell to not be displayed. However, the actual value (0) remains in the cell.

Hide error values by turning the text white

Use the following procedure to format cells that contain errors so that the text in those cells is displayed in a white font. This makes the error text in these cells virtually invisible.

15. Select the range of cells that contain the error value.
16. On the Home tab, in the Styles group, click the arrow next to **Conditional Formatting** and then click **Manage Rules**. The Conditional Formatting Rules Manager dialog box appears.
17. Click New Rule.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

18. The **New Formatting Rule** dialog box appears.
19. Under Select a Rule Type, click Format only cells that contain.
20. Under Edit the Rule Description, in the Format only cells with list, select Errors.
21. Click Format, and then click the Font tab.
22. Click the arrow to open the Color list, and under Theme Colors, select the white color.

Hide error values by making the cell look empty.

In the error example given above the formula **=B1/C1**, where the #DIV/0! error appeared in cell A1 we can use quoted in the IFERROR to show a blank cell. The function would then look like **=IFERROR(B1/C1,"")**. The two quotes at the end of the IFERROR will make the cell look blank.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Chapter Assignments and Tests

To assess your understanding of the material covered in the chapter, please complete the following assignments.

Chapter 3.1 Skills Review

Part A Exercise 1

Difficulty: Level 1 Easy

The challenge of pursuing any position in a retail career is analyzing large volumes of data to measure the financial performance of the business. Large retail corporations may service thousands of customers in hundreds of stores every day. This creates an enormous amount of sales data that is typically stored in large database systems. A retail analyst is typically asked to make sense of all this data and develop reports for other managers in the company. In fact, a retail analyst is often asked to prepare sales reports for the most senior executives in a retail corporation. The skills covered in this chapter are extremely valuable in helping a retail analyst summarize large volumes of data that allow other managers to understand the financial performance of the company and make critical decisions every day. In this exercise, you will create a sales report like one that is commonly used in a retail career. This part of the exercise utilizes the IF function to analyze the sales and inventory data by store. The information created from this analysis can be shared with a manager in the shipping department. Begin this exercise by opening the file named Chapter 3 CiP Exercise 1. You will link to your assumption table in the functions. The Excel file contains the following named cells for you.

Use in Instruction	Cell Name	Cell Location	Value
2.a., 14	ChangeInSales	C30	5%
5	StoreSize	C31	10,000
5	WeeksSupply	C32	8
9	MinWeeksSupply	C33	4
10	OverSupply	C34	8
14	WeeksTooLow	C35	5

1. Click cell D3 on the **Sales by Store** worksheet. Set the Freeze Panes command by clicking the View tab of the Ribbon and then clicking the Freeze Panes button. Select the Freeze Panes option from the drop-down list. This will keep the column headings and store numbers in view as you scroll through the worksheet.

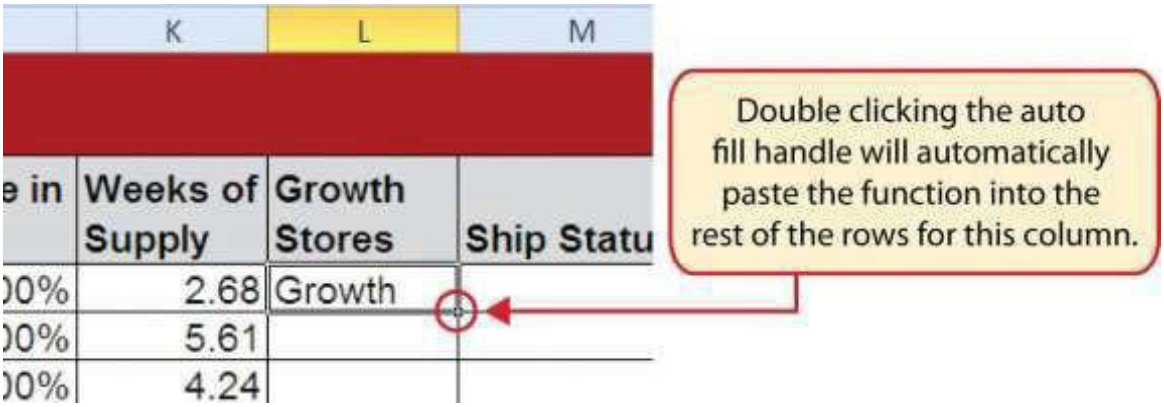
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Management wants to know which stores have shown more than a 5% growth. We will test the Change in Sales column to show the result of Growth, or a blank cell.

2. Click cell L3 on the **Sales by Store** worksheet. Enter an IF function by typing an equal sign (=) followed by the function name **IF** and an open parenthesis (**(**). Define the arguments of the function as follows:
    a. **Logical_test:** The logical test will assess if the value in cell J3 is greater than 5%. Click cell J3 and use the named cell ChangeInSales. Complete the argument by typing a comma.
    b. **Value_if_true:** If the logical test is true, the function should show the word *Growth*. Type the word **"Growth"** with the quotation marks as shown. Complete the argument by typing a comma.
    c. **Value_if_false:** If the logical test is false, the function should leave the cell blank. To do this, type two quotation marks (**""**). Complete the function by typing a closing parenthesis and press the ENTER key on your keyboard.

3. Copy and paste the IF function in cell L3 into the range L4:L26 by double clicking the Auto Fill Handle (see Figure 3.54). You will see the word Growth only for stores where sales are growing at a rate greater than 5% compared to last year. The other cell locations in this column will remain blank if the growth rate is at or less than 5%. *Figure 3.54*

Double click the Auto Fill Handle to copy and paste formulas and functions.



The next thing management wants to know is which small stores should receive any shipments until their inventory levels are lower than an 8-week supply.

4. Click cell M3 on the **Sales by Store** worksheet. This column will nest the AND function within the IF function to identify small stores that cannot receive any shipments until more inventory is sold. Begin the function by typing an equal sign (=) followed by the function name **IF** and an open parenthesis (**(**). Define the arguments of the function as follows:

5. Logical_test: The logical test will assess if the store size in cell F3 (Size) is equal to 10,000 **and** if the weeks of supply in cell K3 is greater than 8. This will require the use of the AND

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

function. Type the function name =IF(AND followed by an open parenthesis. Define the first argument by clicking cell F3 and then typing the following: = StoreSize. Type a comma and define the second argument by clicking cell K3 and then typing the following: >WeeksSupply. Type a closing parenthesis followed by a comma (),).

6. Value_if_true: If the logical test is true, the function should show the word HOLD. Type "HOLD" with the quotation marks as shown. Complete the argument by typing a comma.

7. Value_if_false: If the logical test is false, the function should show the word OK. Type "OK" with the quotation marks as shown. Complete the function by typing a closing parenthesis and press the ENTER key on your keyboard.

8. Copy and paste the IF function in cell M3 into the range M4:M26 by double clicking the Auto Fill Handle. The function now shows for any store that is 10,000 square feet if shipments should be held.

9. Click cell N3 on the **Sales by Store** worksheet. This column will show all stores where the inventory is too high, low, or normal. This will require a nested IF function. Begin the function by typing an equal sign (**=**) followed by the function name **IF** and an open parenthesis (**(**). Define the arguments of the function as follows:

   a. **Logical_test:** The first logical test will assess if the weeks of supply in cell K3 is less than 4. Click cell K3 and then type <MinWeeksSupply. Complete the argument by typing a comma.

   b. **Value_if_true:** If the logical test is true, the function should show the word *LOW*. Type "LOW" with the quotation marks as shown. Complete the argument by typing a comma.

   c. **Value_if_false:** This argument will be used to begin a second IF function. Type the function name **IF** and an open parenthesis (**(**). Define the arguments of this second IF function as follows:

10. Logical_test: This second logical test will assess if the weeks of supply in cell K3 represents too much inventory. If the weeks supply is greater than 8, the store has too much inventory. Click cell K3 and then type >OverSupply. Complete the argument by typing a comma.

11. Value_if_true: If the logical test is true, the function should show the word HIGH. Type

12. "HIGH" with the quotation marks as shown. Complete the argument by typing a comma.

13. Value_if_false: IF the second logical test is false, the function should show the word NORMAL. Type "NORMAL" with the quotation marks as shown. Complete the function by typing two closing parentheses ())). Press the ENTER key.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

14. Copy and paste the IF function in cell N3 into the range N4:N26 by double clicking the Auto Fill Handle. The function now highlights for each store if the inventory is low, high, or normal.

15. Next, we will prioritize shipments to those stores that have a change in sales > 5%, or their weeks supply of inventory is less than 5. Click cell O3 on the Sales by Store worksheet. This column will use the OR function within the IF function to identify stores that should be prioritized for merchandise shipments. Begin the function by typing an equal sign (=) followed by the function name IF and an open parenthesis (**(**). Define the arguments of the function as follows:

    a. **Logical_test:** The logical test will assess if the change in sales in cell J3 is greater than 5% *or* if the weeks of supply in cell K3 is less than 5. This will require the use of the OR function. Type the function name **OR** followed by an open parenthesis (**(**). Define the first argument by clicking cell J3 and then typing the following:**>ChangeInSales** Type a comma and define the second argument by clicking cell K3 and then typing the following: **<WeeksTooLow**. Type a closing parenthesis followed by a comma **),**.

    b. **Value_if_true:** If the logical test is true, the function should show the word *Priority*. Type **"Priority"** with the quotation marks as shown. Complete the argument by typing a comma.

    c. **Value_if_false:** If the logical test is false, the function should leave the cell blank. Todo this, type two quotation marks **("")**. Complete the function by typing a closing parenthesis and press the ENTER key on your keyboard.

16. Copy and paste the IF function in cell O3 into the range O4:O26 by double clicking the Auto Fill Handle. The function now shows the word *Priority* for any store that is experiencing high sales growth or low inventory. This information can also be used by a shipping manager to prioritize the flow of deliveries to the stores.

17. Make a 3-line title that reads Shipping Department, Shipping Analysis, 4th Quarter 2025. (Do not insert a new row. Edit the title already in the file.)

18. Save the workbook. Close the workbook and Excel.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.55Completed CiP Exercise 1 Sales by Store Worksheet (Columns L–O)

Region Number	Region	Weeks of Supply	Growth Stores	Ship Status	Inventory Status	Priority
1	Northeast	2.68	Growth	OK	LOW	Priority
2	South	5.61	Growth	OK	NORMAL	Priority
1	Northeast	4.24	Growth	OK	NORMAL	Priority
1	Northeast	9.47		HOLD	HIGH	
1	Northeast	6.48	Growth	OK	NORMAL	Priority
3	Midwest	7.34	Growth	OK	NORMAL	Priority
1	Northeast	8.49	Growth	OK	HIGH	Priority
2	South	11.11	Growth	HOLD	HIGH	Priority
2	South	10.20		OK	HIGH	
3	Midwest	8.00		OK	NORMAL	
1	Northeast	12.50		HOLD	HIGH	
1	Northeast	7.55	Growth	OK	NORMAL	Priority
1	Northeast	10.20		HOLD	HIGH	
4	West	16.48		HOLD	HIGH	
3	Midwest	6.60	Growth	OK	NORMAL	Priority
4	West	9.28		OK	HIGH	
1	Northeast	9.00		HOLD	HIGH	
2	South	4.72	Growth	OK	NORMAL	Priority
3	Midwest	12.63		HOLD	HIGH	
4	West	14.29		OK	HIGH	
1	Northeast	3.70	Growth	OK	LOW	Priority
3	Midwest	2.68	Growth	OK	LOW	Priority
3	Midwest	15.22		OK	HIGH	
4	West	9.00		OK	HIGH	

Chapter 3.2 Skills Review

Retail Sales Analyst (Comprehensive Review Part B)

Starter File: Chapter 3 CiP Exercise 1 (Continued from Comprehensive Review Part A – make any corrections needed before starting this assignment.)

Difficulty: Level 2 Moderate

This exercise continues the career theme for a retail analyst. In this exercise, you will summarize the detailed sales data using the statistical IF functions. The report will summarize the store level detail by region, which could be used by senior executives of the company. Begin this exercise by opening your corrected file named Chapter 3 CiP Exercise.

1. We will begin by naming ranges in the Sales by Store worksheet. Highlight cells A2:K26. From the Defined Names section of the Formula tab, click on Create from Selection. Make sure only Top Row is checked and then click OK.
2. Click cell C3 on the **Summary Report** worksheet. This column will be used to count the stores for each region of the company. Begin the function by clicking the Formulas

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

tab on the Ribbon. Click the More Functions button, click the Statistical option, and then click the COUNTIF function from the list. Define the arguments in the Function Arguments dialog box as follows:

- **Range:** In the **Range** argument, click on Use in Formula from the Defined Names section of the Formula. Select Region_Number. Press the TAB key on your keyboard to advance to the next argument.
- **Criteria:** Type cell **A3**. Complete the function by clicking the OK button at the bottom of the Function Arguments dialog box.

3. Copy and paste the COUNTIF function in cell C3 by double clicking the Auto Fill Handle. The function will show the number of stores for each region.
4. Click cell D3 on the **Summary Report** worksheet. This column will be used to sum the current sales by region. Begin the function by clicking the Formulas tab on the Ribbon. Click the Math & Trig button and select the SUMIF function from the list. Define the arguments in the Function Arguments dialog box as follows:
   - **Range:** Click in the input box for the **Range** argument. Go to the Use in Formula drop-down, select Region_Number. Press the TAB key on your keyboard to advance to the next argument.
   - **Criteria:** Type cell **A3**. Press the TAB key on your keyboard to advance to the next argument.
   - **Sum_range:** Click in the input box for the **Sum_range** argument. Go to the Use in Formula drop-down, select Sales_This_Year. Complete the function by clicking the OK button at the bottom of the Function Arguments dialog box.
5. Copy and paste the SUMIF function in cell D3 by double clicking the Auto Fill Handle. The function will show the total sales this year for each region.
6. Click cell E3 on the **Summary Report** worksheet. This column will be used to sum the sales last year by region. Enter a SUMIF function and define the arguments exactly as stated in step 3. However, define the **Sum_range** argument with the named range Sales_Last_Year.
7. Copy and paste the SUMIF function in cell E3 by double clicking the Auto Fill Handle. The function will show the total sales for last year for each region.
8. Enter a formula in cell F3 on the **Summary Report** worksheet to calculate the percent change in sales for each region. Your formula should first subtract the Sales Last Year in cell E3 from the Sales This Year in cell D3. Then divide this result by the Sales Last Year in cell E3.
9. Copy and paste the formula in cell F3 by double clicking the Auto Fill Handle.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

10. Click cell C11 on the **Summary Report** worksheet. This column will be used to count the number of stores by size for the region number typed into cell B9. Begin the function by clicking the Formulas tab on the Ribbon. Click the More Functions button, click the Statistical option, and select the COUNTIFS function from the list. Define the arguments in the Function Arguments dialog box as follows:
    - **Criteria_range1:** Click in the input box for the **Range** argument. Go to the Use in Formula drop-down, select Region_Number. Press the TAB key on your keyboard to advance to the next argument.
    - **Criteria1:** Type cell **B9**. Place an absolute reference on this cell location. Press the TAB key on your keyboard to advance to the next argument.
    - **Criteria_range2:** Click in the input box for the **Range** argument. Go to the Use in Formula drop-down, select Size_Square_Feet. Press the TAB key on your keyboard to advance to the next argument.
    - **Criteria2:** Type cell **B11**. Complete the function by clicking the OK button at the bottom of the Function Arguments dialog box.
11. Copy the COUNTIFS function in cell C11 and paste it into the range C12:C14 using the Paste Formulas command.
    - Click cell D11 on the **Summary Report** worksheet. The Sales This Year column will be used to sum the current sales by store size for the region number typed into cell B9. Begin the function by clicking the Formulas tab on the Ribbon. Click the Math & Trig button and select the SUMIFS function from the list. Define the arguments in the Function Arguments dialog box as follows:
    - **Sum_range:** Click in the input box for the **Range** argument. Go to the Use in Formula drop-down, select Sales_This_Year. Press the TAB key on your keyboard to advance to the next argument.
    - **Criteria_range1:** Click in the input box for the **Range** argument. Go to the Use in Formula drop-down, select Region_Number. Press the TAB key on your keyboard to advance to the next argument.
    - **Criteria1:** Type cell **B9**. Place an absolute reference on this cell location. Press the TAB key on your keyboard to advance to the next argument.
    - **Criteria_range2:** Click in the input box for the **Range** argument. Go to the Use in Formula drop-down, select Size_Square_Feet. Press the TAB key on your keyboard to advance to the next argument.
    - **Criteria2:** Type cell **B11**. Complete the function by clicking the OK button at the bottom of the Function Arguments dialog box.
12. Copy the SUMIFS function in cell D11 and paste it into the range D12:D14 using the Paste Formulas command.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

13. Click cell E11 on the **Summary Report** worksheet. This column will be used to sum the sales last year by store size for the region number typed into cell B9. Enter a SUMIFS function into this cell location and define the arguments exactly as stated for step 11. However, define the **Sum_range** argument with the named range Sales_Last_Year.
14. Copy the SUMIFS function in cell E11 and paste it into the range E12:E14 using the Paste Formulas command.
15. Enter a formula in cell F11 on the **Summary Report** worksheet to calculate the percent change in sales for each store size. Your formula should first subtract the Sales Last Year in cell E11 from the Sales This Year in cell D11. Then divide this result by the Sales Last Year in cell E11.
16. Copy the formula in cell F11 and paste it into the range F12:F14 using the Paste Formulas command.
17. Place a conditional format on the range F11:F14 to show any negative numbers in red. Begin by highlighting the range F11:F14 on the **Summary Report** worksheet. Click the Conditional Formatting button in the Home tab of the Ribbon and select the New Rule option from the drop-down list. Click the "Format only cells that contain" option from the New Formatting Rule dialog box. Change the comparison operator box from "between" to "less than". Click in the input box next to the comparison operator box and type a **0**. Click the Format button and change the text color to red. Complete the command by clicking the OK button in the Format Cells dialog box and in the New Formatting Rule dialog box.
18. Save the workbook by adding your name in front of the current workbook name(i.e., "*your name* Chapter 3 CiP Exercise 1").

Chapter 3.3 & 3.4 Skills Review Part C

Retail Sales Analyst (Comprehensive Review Part C)

Starter File: Chapter 3 CiP Exercise 1 (Continued from Comprehensive Review Part B)
Difficulty: Level 2 Moderate

This exercise continues the career theme for a retail analyst. In this exercise, you will summarize the detailed sales data using the statistical IF functions. The report will summarize the store level detail by region, which could be used by senior executives of the company. Begin this exercise by opening your corrected file named Chapter 3 CiP Exercise 1.

1. On the **Region Plan worksheet**, highlight the cells B2:B5. Name the range RegionNum. Select cells A3:E5.On the Formula ribbon use the Create from Selection to name the ranges based on the left column. These named ranges provide the arrays for the following functions.

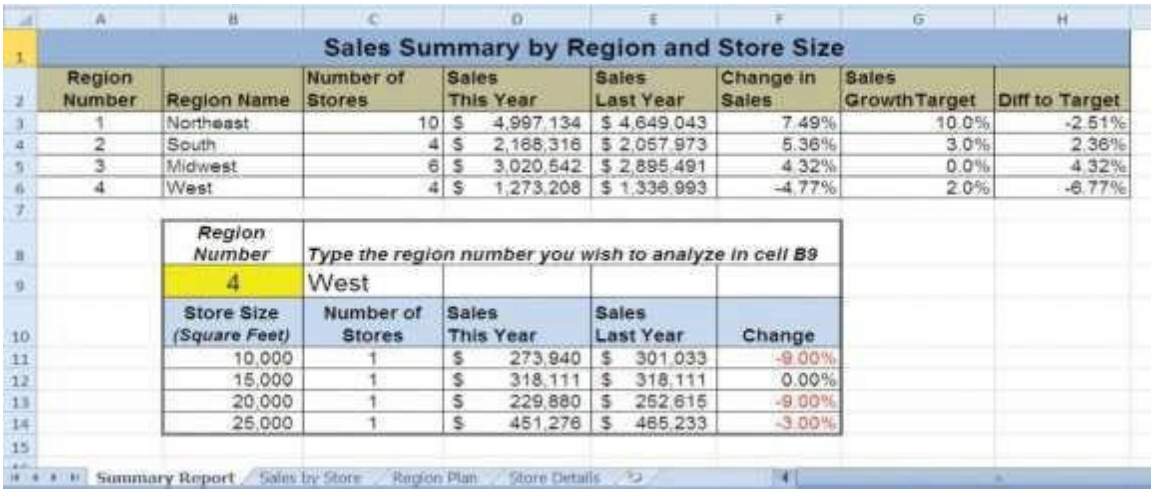
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

2. Click cell G3 on the **Summary Report** worksheet. The purpose of this column is to show the sales growth target for each region. The sales growth targets can be found in the **Region Plan** worksheet. An XLOOKUP function will be used to display the sales growth plan for each region. Begin the function by clicking the Formulas tab of the Ribbon. Then click the Lookup & Reference button and select the XLOOKUP function from the list. Define the arguments of the function as follows:
   a. **lookup_value:** Click on cell **A3** in the input box for this argument. Then press the TAB key on your keyboard to advance to the next argument.
   b. **lookup_array:** Click on the Use in Formulas button on the Functions Tab. Select the named range RegionNum. Press the TAB key on your keyboard to advance to the next argument.
   c. **return_array:** Click on the Use in Formulas button on the Functions Tab. Select the named range Growth_Target.
3. Copy and paste the XLOOKUP function in cell G3 by double clicking the Auto Fill Handle.
4. Enter a formula in cell H3 that subtracts the Sales Growth Target in cell G3 from the Change in Sales in cell F3 **(F3−G3)**. Then copy and paste the formula into the range H4:H6.
5. In cell B9 create a data validation list with the numbers 1,2,3,4. For the Validation **message** use: Enter region number. For the Stop error **message** use: Valid region numbers are 1 – 4. (You do not need to put titles in the input or stop messages. Only use the message box.)
6. Click cell C9 on the **Summary Report** worksheet. The purpose of this cell is to display the name of the region for the number that is typed into cell B9. This will be accomplished by using an XLOOKUP function. Begin the function by clicking the Formulas tab of the Ribbon, then click the Lookup & Reference button and select the XLOOKUP function from the list. Define the arguments of the function as follows:
   a. Highlight the range A3:A6 on the Summary Report worksheet and name the range Summary_Region_Number. Highlight the range B3:B6 on the Summary Report and name the range Summary_Region_Name
   b. **Lookup_value:** Type cell **B9** in the input box for this argument and press the TAB key on your keyboard to advance to the next argument.
   c. **lookup_array:** Click on the Use in Formulas button on the Functions Tab. Select the named range Summary_Region_Number for the lookup_array. Press the TAB key on your keyboard to advance to the next argument.
   d. **Return_array:** Click on the Use in Formulas button on the Functions Tab. Select the named range Summary_Region_Name for the return_array.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

7. Place a conditional format on the range F11:F14 to show any negative numbers in red. Begin by highlighting F11:F14 on the **Summary Report** worksheet. Click the Conditional Formatting button in the Home tab of the Ribbon and select the New Rule option. Click the "Format only cells that contain" option from the New Formatting Rule dialog box. Change the comparison operator box from "between" to "less than". Click in the input box next to the comparison operator box and type a **0**. Click the Format button and change the text color to red.
8. Looking at the **Summary Report** worksheet, you will notice that the change in sales for the West region is −4.77%. Type the number 4 in cell B9 to see the change in sales summarized for each store size in the region. Examine the sales results by store size for each of the other three regions. Notice that even if a region shows an increase in sales over last year, it does not necessarily mean that all stores in that region are performing well.
9. Save the workbook by adding your name in front of the current workbook name(i.e., "*your name* Chapter 3 CiP Exercise 1").
10. Close the workbook and Excel.

Figure 3.56Completed CiP Exercise 1 Summary Report Worksheet



Sales Summary by Region and Store Size

Region Number	Region Name	Number of Stores	Sales This Year	Sales Last Year	Change in Sales	Sales Growth Target	Diff to Target
1	Northeast	10	$ 4,997,134	$ 4,649,043	7.49%	10.0%	-2.51%
2	South	4	$ 2,168,316	$ 2,057,973	5.36%	3.0%	2.36%
3	Midwest	6	$ 3,020,542	$ 2,895,491	4.32%	0.0%	4.32%
4	West	4	$ 1,273,208	$ 1,336,993	-4.77%	2.0%	-6.77%

Region Number	Type the region number you wish to analyze in cell B9			
4	West			
Store Size (Square Feet)	Number of Stores	Sales This Year	Sales Last Year	Change
10,000	1	$ 273,940	$ 301,033	-9.00%
15,000	1	$ 318,111	$ 318,111	0.00%
20,000	1	$ 229,880	$ 252,615	-9.00%
25,000	1	$ 451,276	$ 465,233	-3.00%

Summary Report | Sales by Store | Region Plan | Store Details

IF Function Case Study: Payroll for a Medical Group

Starter File: Chapter 3 CiP Exercise 2 Difficulty: Level 2

Moderate

Medical groups are common in the health care industry and range in size. The defining trait of a medical group is that there is more than one doctor on staff for a particular practice, which creates more flexible hours for patients and physicians. In addition, a medical group can provide a variety of medical services in one location. This exercise illustrates how to use the skills presented in this chapter to summarize payroll details for employees working in a medical group. Begin this exercise by opening the file named Chapter 3 CiP Exercise 2.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

1. Set the Freeze Panes command on the **Payroll Details** worksheet so that Rows 1 and 2 and Columns A and B are locked in place while scrolling through the worksheet.
2. As you work through this assignment, set up your assumption table, name cells and use the named cells/ranges in your functions.
3. Enter an IF function in cell G3 on the **Payroll Details** worksheet to calculate the Social Security tax.

   Social Security funds are used by the government to provide income for people who are retired, a beneficiary of a retiree, or disabled. An employer must withhold 4.2% of an employee's weekly pay for Social Security. However, an employee is only taxed up to $160,200. The logical test of the IF function should assess if the value in the Pay Year to Date column is greater than or equal to 160200. If the logical test is true, the output of the function should be zero. Otherwise, the function should multiply the value in the Gross Pay This Week by 4.2%. Copy and paste the function into the range G4:G22.
3. Enter a formula in cell H3 on the **Payroll Details** worksheet that calculates the Medicare Tax. Medicare funds are used by the government to provide medical financial support to senior citizens. Your formula should multiply the Gross Pay This Week by 1.45%. Copy and paste this formula into the range H4:H22.
4. Enter a formula in cell I3 on the **Payroll Details** worksheet that calculates the total FICA tax (FICA stands for Federal Insurance Contributions Act). Your formula should add the Social Security Tax to the Medicare Tax. Copy and paste this formula into the range I4:I22.
5. Enter an IF function in cell J3 on the **Payroll Details** worksheet to calculate the Federal Tax. If the Gross Pay This Week is less than or equal to 1150, then the tax is calculated by multiplying the Gross Pay This Week by 20%. Otherwise, this tax is calculated by multiplying the Gross Pay This Week by 25%. Copy and paste the IF function into the range J4:J22.
6. If an employee has been working with the medical group for 1 or more years, the company will match 50% of the employee's 401(k) retirement contributions. Calculate the company's 401(k) retirement contributions by entering an IF function in cell L3 on the **Payroll Details** worksheet. If the Years of Service is greater than or equal to 1, multiply the 401K Retirement value by 50%. Otherwise, the output of the function should be zero. Copy and paste the IF function into the range L4:L22.
7. The medical group offers its employees an additional retirement benefit based on the employee's position and years of service. Employees who have been with the practice 3 or more years will receive an additional contribution to their retirement account. Calculate this benefit by entering an IF function in cell M3 on the Payroll Details worksheet. If an employee is a physician and has been working in the medical group for 3 or more years, the function should multiply the Gross Pay This Week by 8%. For all

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

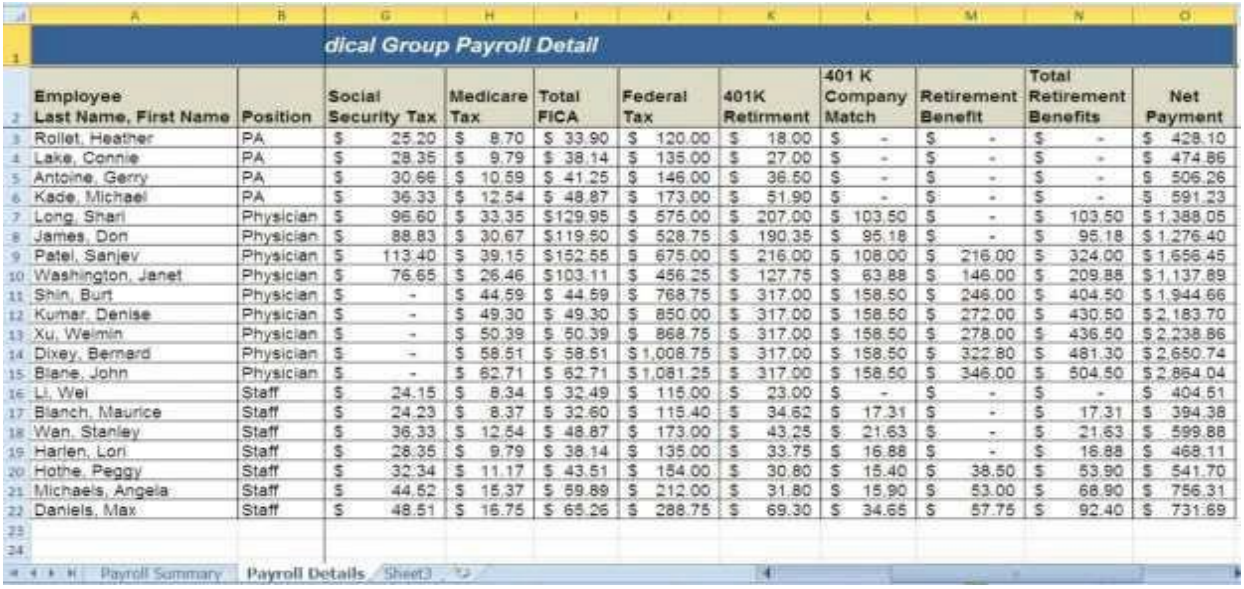
other employees who have been working at the medical group for 3 or more years, the function should multiply the Gross Pay This Week by 5%. Copy and paste the function into the range M4:M22.

8. Enter a formula into cell N3 on the **Payroll Details** worksheet that calculates the Total Retirement Benefits. Your formula should add the 401K Company Match value to the Retirement Benefit value. Copy and paste the formula into the range N4:N22.
9. Enter a formula into cell O3 on the **Payroll Details** worksheet that calculates the Net Payment for each employee. Your formula should subtract the values in the range I3:K3 from the Gross Pay This Week in cell F3. The range I3:K3 includes the following: Total FICA (cell I3), Federal Tax (cell J3), and 401K Retirement (cell K3). Copy and paste this formula into the range O4:O22. (Your instructions may tell you to stop after this step. If so do not proceed with the remaining steps.)
10. Enter a COUNTIF function into cell B3 on the **Payroll Summary** worksheet. The function should count the number of employees in the range A3:A22 on the **Payroll Details** worksheet for each Practice listed in Column A on the **Payroll Summary** worksheet. Copy and paste the function into the range B4:B7.
11. Enter an AVERAGEIF function into cell C3 on the **Payroll Summary** worksheet. The function should calculate the average Years of Service in the range D3:D22 on the **Payroll Details** worksheet for each Practice listed in Column A on the **Payroll Summary** worksheet. Copy and paste the function into the range C4:C7.
12. Enter a SUMIF function into cell D3 on the **Payroll Summary** worksheet. The function should sum the Total FICA tax in the range I3:I22 on the **Payroll Details** worksheet for each Practice listed in Column A on the **Payroll Summary** worksheet. However, the government requires that employers match the FICA tax that is withheld from employees' paychecks. Therefore, multiply the result of this SUMIF function by 2. Copy and paste the function into the range D4:D7.
13. Enter a SUMIF function into cell E3 on the **Payroll Summary** worksheet. The function should sum the Federal Tax withholdings in the range J3:J22 on the **Payroll Details** worksheet for each Practice listed in Column A on the **Payroll Summary** worksheet. Copy and paste the function into the range E4:E7.
14. Enter a SUMIF function into cell F3 on the **Payroll Summary** worksheet. The function should sum the Net Payments in the range O3:O22 on the **Payroll Details** worksheet for each Practice listed in Column A on the **Payroll Summary** worksheet. Copy and paste the function into the range F4:F7.
15. Enter a SUMIF function into cell G3 on the **Payroll Summary** worksheet. The function should sum the Total Retirement Benefits in the range N3:N22 on the **Payroll Details** worksheet for each Practice listed in Column A on the **Payroll Summary** worksheet. Copy and paste the function into the range G4:G7.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

16. Enter a SUM function in cell B8 on the **Payroll Summary** worksheet that sums the values in the range B3:B7. Copy and paste this SUM function into the range D8:G8. Then format the range D8:G8 to the Accounting number format.
17. Save the workbook by adding your name in front of the current workbook name (i.e., "*your name* Chapter 3 CiP Exercise 2").
18. Close the workbook and Excel.

Figure 3.57Completed CiP Exercise 2 Payroll Details Worksheet (Columns G–O)

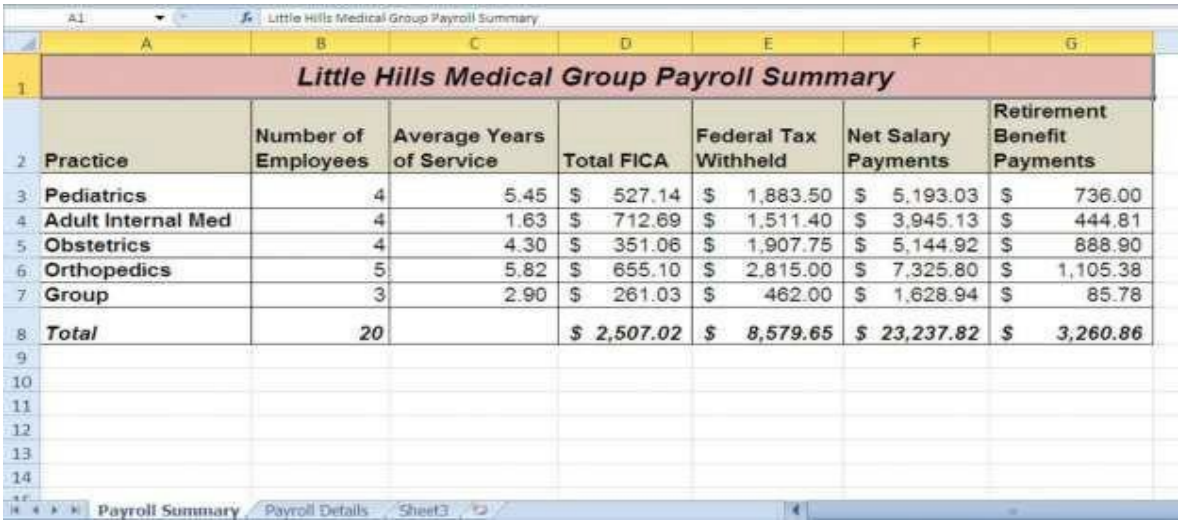


dical Group Payroll Detail

Employee Last Name, First Name	Position	Social Security Tax	Medicare Tax	Total FICA	Federal Tax	401K Retirment	401 K Company Match	Retirement Benefit	Total Retirement Benefits	Net Payment
Rollet, Heather	PA	$ 25.20	$ 8.70	$ 33.90	$ 120.00	$ 18.00	$ -	$ -	$ -	$ 428.10
Lake, Connie	PA	$ 28.35	$ 9.79	$ 38.14	$ 135.00	$ 27.00	$ -	$ -	$ -	$ 474.86
Antoine, Gerry	PA	$ 30.66	$ 10.59	$ 41.25	$ 146.00	$ 36.50	$ -	$ -	$ -	$ 506.26
Kade, Michael	PA	$ 36.33	$ 12.54	$ 48.87	$ 173.00	$ 51.90	$ -	$ -	$ -	$ 591.23
Long, Shari	Physician	$ 96.60	$ 33.35	$129.95	$ 575.00	$ 207.00	$ 103.50	$ -	$ 103.50	$ 1,388.05
James, Don	Physician	$ 88.83	$ 30.67	$119.50	$ 528.75	$ 190.35	$ 95.18	$ -	$ 95.18	$ 1,276.40
Patel, Sanjev	Physician	$ 113.40	$ 39.15	$152.55	$ 675.00	$ 216.00	$ 108.00	$ 216.00	$ 324.00	$ 1,656.45
Washington, Janet	Physician	$ 76.65	$ 26.46	$103.11	$ 456.25	$ 127.75	$ 63.88	$ 146.00	$ 209.88	$ 1,137.89
Shin, Burt	Physician	$ -	$ 44.59	$ 44.59	$ 768.75	$ 317.00	$ 158.50	$ 246.00	$ 404.50	$ 1,944.66
Kumar, Denise	Physician	$ -	$ 49.30	$ 49.30	$ 850.00	$ 317.00	$ 158.50	$ 272.00	$ 430.50	$ 2,183.70
Xu, Weimin	Physician	$ -	$ 50.39	$ 50.39	$ 868.75	$ 317.00	$ 158.50	$ 278.00	$ 436.50	$ 2,238.86
Dixey, Bernard	Physician	$ -	$ 58.51	$ 58.51	$ 1,008.75	$ 317.00	$ 158.50	$ 322.80	$ 481.30	$ 2,650.74
Blane, John	Physician	$ -	$ 62.71	$ 62.71	$ 1,081.25	$ 317.00	$ 158.50	$ 346.00	$ 504.50	$ 2,864.04
Li, Wei	Staff	$ 24.15	$ 8.34	$ 32.49	$ 115.00	$ 23.00	$ -	$ -	$ -	$ 404.51
Blanch, Maurice	Staff	$ 24.23	$ 8.37	$ 32.60	$ 115.40	$ 34.62	$ 17.31	$ -	$ 17.31	$ 394.38
Wan, Stanley	Staff	$ 36.33	$ 12.54	$ 48.87	$ 173.00	$ 43.25	$ 21.63	$ -	$ 21.63	$ 599.88
Harlen, Lori	Staff	$ 28.35	$ 9.79	$ 38.14	$ 135.00	$ 33.75	$ 16.88	$ -	$ 16.88	$ 468.11
Hothe, Peggy	Staff	$ 32.34	$ 11.17	$ 43.51	$ 154.00	$ 30.80	$ 15.40	$ 38.50	$ 53.90	$ 541.70
Michaels, Angela	Staff	$ 44.52	$ 15.37	$ 59.89	$ 212.00	$ 31.80	$ 15.90	$ 53.00	$ 68.90	$ 756.31
Daniels, Max	Staff	$ 48.51	$ 16.75	$ 65.26	$ 288.75	$ 69.30	$ 34.65	$ 57.75	$ 92.40	$ 731.69

Payroll Summary | Payroll Details | Sheet3

Figure 3.58Completed CiP Exercise 2 Payroll Summary Worksheet



Little Hills Medical Group Payroll Summary

Practice	Number of Employees	Average Years of Service	Total FICA	Federal Tax Withheld	Net Salary Payments	Retirement Benefit Payments
Pediatrics	4	5.45	$ 527.14	$ 1,883.50	$ 5,193.03	$ 736.00
Adult Internal Med	4	1.63	$ 712.69	$ 1,511.40	$ 3,945.13	$ 444.81
Obstetrics	4	4.30	$ 351.06	$ 1,907.75	$ 5,144.92	$ 888.90
Orthopedics	5	5.82	$ 655.10	$ 2,815.00	$ 7,325.80	$ 1,105.38
Group	3	2.90	$ 261.03	$ 462.00	$ 1,628.94	$ 85.78
Total	*20*		*$ 2,507.02*	*$ 8,579.65*	*$ 23,237.82*	*$ 3,260.86*

Payroll Summary | Payroll Details | Sheet3

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

XLOOKUP, IFERROR and Data Validation

Starter File: XLOOKUP IFERROR and DataValidation.xlsx

Difficulty: Level 3 Difficult

Amy Woodward is the manager of the Lane Community College Titan Bookstore which sells products to loyal alums of Lane Community College. Products offered by Amy on the website range from tee shirts and backpacks to mugs and blankets – and all feature the school's logo. Alice has a large, steady base of customers who find these uniquely designed products a great reminder of their college days. To ensure the timely recipe of payments, Alice wants you to use Excel to create an invoice she can use for each customer transaction. Complete the following:

1. Open the file XLOOKUP IFERROR and Data Validation.xlsx
2. In the Data worksheet name the following ranges
   a. Shipping cost: Name E2:I2, OrderAmount and E3:I3 ShippingCost
   b. Product price list: B3:B28, PriceList
   c. Items list: A3:A28, Items
   d. Sales Tax : Name D6:D7 TaxState Name E6:E7 SalesTax.
   e. In the States worksheet: name the range B2:B52, StateAbbr

In the Invoice worksheet:

3. Name the Subtotal cell in H37 OrderTotal
4. Use a data validation list in cell D12 to bring up the state abbreviations.
5. Use data validation lists in the range B16:B36 to bring up the list of products in the cells. (Hint: name the range before setting the validation rules.)
6. In the Per Unit Column G (the range G16:G36) use the XLOOKUP function to retrieve the per-unit price of each ordered product from the Product Pricing data in the Product and Shipping worksheet. (Hint: Use the defined names from above.) Test your XLOOKUP by selecting blanket cell B16. If it gives the correct result, proceed to step 8. If not, correct your XLOOKUP.
7. Modify the formula in the Per Unit column by using the if_not_found argument in the XLOOKUP to return a blank cell. Two quote marks will work. With the if_not_found argument used XLOOKUP function will display either the per-unit price or a blank cell. Copy the formula down through row 36. Format the column appropriately.
8. In the Total Column (the range H16:H36), enter the formula to calculate the total charge for that row (Qty * price per unit). After you have determined your formula is working correctly, use an IFERROR to function to display either the total charge or a blank cell. Copy the formula down through row 36.
9. In the Subtotal cell (cell H37), add a formula to sum the Total column. Format the cell appropriately.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

10. In the Sales Tax cell (cell H38) enter a formula using a nested IF that uses an OR to test D12 to check if the state is CA or WA. For the true result use XLOOKUP that looks at the state abbreviation in D12 and compares it to the named range TaxState to return the sales tax percent from SalesTax. Multiply the result of your nested IF function by the Subtotal to calculate total sales tax due.
11. In the Shipping cell H39, use the XLOOKUP function to use the OrderAmount range to look up the shipping cost from the ShippingCost range in the Data worksheet based on the OrderTotal in sell H37. You will need an inexact match.
12. In the Total Due cell (cell H40), calculate the invoice total by entering a formula that adds the values in the Subtotal, Sales Tax, and Shipping cells. Format this cell appropriately.

    Test the Worksheet using the following data: (Leave test data in your file before submitting.)

Sold to	Ellen Farmer
Address:	222 Central Avenue
	West Covina, CA 91790
Date:	06/15/2025
Items Ordered	Blanket, 2 Duffle Bag – Large, 1 Scarf, 3

Financial Function Case Problem:

Suzy is wanting to purchase a home and is trying to figure out how to arrange the financing for her purchase. This is her first time buying a house and so she is looking at all the financing options available to her. She has a budget she must stay within, so that is a major factor in how she will determine which option to choose. She has savings that she can apply to a down payment. She's not sure if she wants to use all her savings on the down payment. Help her analyze her options by completing the Loan Analysis worksheet. Once a decision has been made about which option to choose, complete the Amortization table for her so she will know how her payments will be applied to interest and principal.

Instructions:

Loan Analysis worksheet:

a. Name the cells E3, E4, and J21 with an appropriate cell name that will convey the contents of the cell.
b. In cells E7:E13 calculate the loan amount borrowed. The amount borrowed will be the difference between the purchase price and the down payment applied to the loan.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

c. In cells F7:F13 calculate the monthly payment amount under each option using the PMT function. Change the payment so it shows a positive rather than a negative number.
d. Answer the analysis questions below the table.

Amortization Table worksheet:

1. In B2, use a 3-D cell reference to link to the loan value for the option you selected in the loan analysis worksheet.
2. In cells B3:B5, link to the appropriate cells from the Loan Analysis worksheet.
3. Name cells B2:B5 using the Create from selection option in the Defined Names section of the Formula ribbon.
4. Based on the option you selected on the Loan Analysis worksheet, starting in A8 of your amortization table, fill the number of payments you will need to make to bring your loan value to 0 by the end of your amortization table. Example 15 years and 4 payments per year would be 15*4=60 payments. Your payments would go from 1 to 60 down the page.
5. Link B8 to your beginning loan value.
6. Create your PPMT, IPMT and remaining balance. (Hint: if you add the IPMT and PPMT values together it should equal the Periodic payment.)
7. Complete the amortization schedule. Your ending balance should be 0.

Statistical Function Case Study

Starter File: Chapter_3_CiP_Invoice Analysis

Science Technologies, Inc has downloaded some raw invoice material from their accounting system. They want to evaluate salesman commissions and the length of time invoices have been outstanding. You will complete the worksheet analysis for them.

In the Invoices Worksheet:

1. You must use named cells and ranges in this assignment! Use the exact names given in the assignment.
2. In the cell H1 enter the date 7/1/2024 as the current date. Then name that cell CurrentDate.
3. In the cell K1 enter 4% as the commission rate. Then name that cell CommissionRate
4. Name the range of cells that contains the Invoice Amounts as InvoiceAmt
5. In the G column calculate the days past due. (CurrentDate – invoice date). Format for number with zero decimal places. Copy the formula down the column then name the range of past due dates DaysPastDue.
6. Name the range of cells that contains the sales reps SalesRep.
7. Calculate the sales rep's commissions by multiplying the commission rate by the invoice amount. Format for comma. Copy formula down the column. Name the commission data, Commissions.
8. Use a COUNT function in G106 to count the number of invoices.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

9. Add totals at the bottom of the Commissions and invoices columns. These will be used as check figures for your Invoice Analysis.
10. Use conditional formatting to highlight past due invoices that are 90 days past due.
11. Format columns appropriately.
    Note: No title necessary because this worksheet contains raw data.

In the Invoice Analysis Worksheet

12. In the B column use a COUNTIF function to count the number of invoices for each sales rep. Do not type the sales rep name in your functions.
13. In the Commission column, use a SUMIF to total the commissions for each sales rep.
14. In the Total Invoice Amount column, use a SUMIF to total the invoices for each sales rep.
15. Create totals at the bottom of each column and format appropriately. (Hint: totals should equal the totals you created row 106 of the Invoices worksheet)
16. In the Nbr Invoices column use COUNTIFS to count the invoices in each aging category. (Hint: You must separate the aging days into separate arguments in your functions.)
17. In the Amount column use SUMIFS to total the invoices in each aging category.
18. Create totals at the bottom of each column and format appropriately. (Hint: totals should equal the totals you created in the Invoices worksheet and in the Sales Rep Analysis on the Invoice Analysis worksheet.
19. In A1 insert a row and add your 3-line title to the Invoice Analysis Worksheet and resize row to fit.
20. Save your file and upload it before the due date and time.

Integrity Check

Starter File: Chapter 3 IC Exercise 3 Difficulty: Level 3 Difficult

The purpose of this exercise is to analyze a worksheet to determine whether there are any integrity flaws. Read the scenario that follows and then open the Excel workbook related to this exercise. You will find a worksheet in the workbook named **AnswerSheet**. This worksheet is to be used for any written responses required for this exercise.

Scenario

You recently became the inventory director for a medium-size apparel retail company. The company relies on you to keep a very close watch on the inventory levels for all the items the company sells. Any apparel inventory that is left unsold after the current season will have to be sold at a significant discount. Large excess amounts of inventory can result in drastic profit losses for the company. The company analyzes inventory based on a sell-through rate, which is the weekly unit sales divided by the current inventory units. A sell-through percentage between 12% and 15% is considered normal. At this rate, the company will sell all inventory for an item in 6 to 8 weeks. However, a sell-through rate that is

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

outside of this range will require immediate action. An analyst has e-mailed you an inventory status report based on the company's inventory management guidelines. He explains the following in his e-mail:

- The Status column of the inventory contains a function I put together that tells us where we have issues. The company suggests that we put a "rush priority" on any inventory orders for more than 100 units in a week and for which the sell-through rate is greater than or equal to 20%.
- If the sell-through rate for any item is less than 10%, we must work with the buyers to see if any incoming orders can be cancelled. The function I created indicates any slow-selling items with a "cancel warning" description.
- Overall, it looks like our biggest problem is that we don't have enough inventory. In fact, most of the items on the report are showing a "rush priority." I guess this is a good problem to have.

Assignment

1. Look at the Status column (Column E) for the first few items on the inventory report. Does the output of the function created by the analyst make sense given the company's guidelines for managing inventory? Document your observation in the **AnswerSheet** worksheet.
2. Evaluate the construction of the IF function in the Status column for the first item. Does the function accurately evaluate the Sell Through percentages in Column D? Document your observation in the **AnswerSheet** worksheet.
3. The company suggests that a rush priority be placed on any orders if the unit sales for an item are greater than 100 and the sell-through rate is greater than or equal to 20%. Does the IF function in the Status column accurately account for this condition? Document your observation in the **AnswerSheet** worksheet.
4. Enter a new IF function in the Status column to accurately assess the inventory for each item based on the company's inventory policies. Make any other adjustments to the worksheet so that it is easy to see all items that require "Rush Priorities" as well "Cancel Warnings."
5. Enter formulas in Columns G, H, and I to calculate the Cost of Purchase, Current Value, and Unrealized Gain/Loss. Refer to Table 3.2 "Definitions for Columns A through G of the Investment Detail Worksheet", Table 3.3 "Definitions for Columns H through K of the Investment Detail Worksheet", and Table 3.5 "Definitions for Columns S through X of the Investment Detail Worksheet" earlier in this chapter if needed to create these formulas.
6. Show the total Unrealized Gain/Loss for the portfolio in cell I8.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

7. For any stock, or for the entire portfolio, that is showing an Unrealized *Loss* in Column I, have Excel automatically change the font color to red and use a bold format.

A Second Look at Federal Income Taxes

Starter File: Chapter 3 AES Assignment 2 Difficulty: Level 3 Difficult

The purpose of this assignment is to revisit the federal payroll tax calculations that were demonstrated in the Careers in Practice: Payroll for a Medical Group exercise. In that exercise, we assumed that if the employee's weekly income was less than or equal to $1,150, the federal tax was estimated at 20%. For any income over $1,150, the federal tax was estimated at 25%. However, the IRS publishes tables that provide more details as to how federal taxes should be calculated and withheld for weekly payrolls.

The Excel workbook for this assignment contains two worksheets. The **Payroll Details** worksheet is a subset of the data that was used for the Careers in Practice exercise. The **Withholding Table** worksheet contains part of an Excel worksheet that was published by the IRS.

There are six levels of weekly income in Columns A and B of the worksheet. Columns C and D provide information for calculating the amount of federal tax that should be withheld. For example, if an employee's weekly salary is $200, you would use Row 3 to calculate the amount of federal tax that should be withheld. This means you would first subtract the value in cell C3 from the weekly salary, which is: 200 − 111.15 = 88.85. Then the result of 88.85 is multiplied by the percentage in cell D3, which is: 88.85 × .10 = 8.885. Therefore, the federal tax that should be withheld for an employee who is paid $200 a week is $8.885. Expressed as a formula, the calculation would be as follows: (200 − 111.15) × .10.

Your assignment is to complete the Federal Tax calculations in Column F of the **Payroll Details** worksheet. You are required to reference the data in the **Withholding Table** worksheet such that if the tax rates change in the future (a very common occurrence), your federal tax calculations will automatically be updated. *Hint: You will need to use the VLOOKUP function twice in your formula.*

Follow the example calculation carefully and manually check the output of your formula to determine whether you are producing an accurate result.

The Smart Grade Book

Starter File: Chapter 3 AES Assignment 3

Difficulty: Level 3 Difficult

The Excel workbook for this assignment contains a partially completed grade book for a typical college- level course. The **Grade Details** worksheet contains a list of hypothetical students who were enrolled in the course as well as the grades they received for each

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

course requirement. Column H contains a formula that calculates the final grade for each student. Table 3.12 "Final Grade Calculation" shows information that was included in the course syllabus that shows students how their final grades will be calculated.

Table 3.12 Final Grade Calculation

Requirement	Percent of Final Grade
Paper 1	10
Paper 2	10
Class	15
Quizzes	10
Midterm Exam	20
Final Exam	35
Special Note	A final grade below a 70 will require that this course be repeated for credit.

The Excel skills demonstrated in this chapter can be used to create a dynamic and "smart" grade book for any academic course. Your assignment is to complete the grade book using several of the Excel skills that you have learned so far. Open the Excel workbook for this assignment and complete the grade book based on the following requirements:

1. It is very important to make sure a student's grade is accurately calculated. One area that must be checked often when calculating final grades is the percentages assigned to each requirement in the course. One way to do this is to see if the percentages add up to 100%. Use an IF function in the merged cells H2 and I2 on the **Grade Details** worksheet to determine if the percentages in the range B2:G2 add up to 100%. If the percentages do not add up to 100%, show the phrase "Percentages do not equal 100%." Otherwise, leave the cell blank (use two quotation marks: ""). Use the results of your IF function to make any necessary adjustments to the grade book (refer to Table 3.12 "Final Grade Calculation" as needed).

2. Calculate class averages in Row 29 for each course requirement as well as the final grades in Columns B through H.

3. Use a VLOOKUP function to display the appropriate letter grade for each student in Column I. The **Grade Table** worksheet contains data that shows how the letter grades should be assigned for the numeric grades. (Hint: review Table 3.10 Arguments for the VLOOKUP Function to see how data must be laid out for the TRUE argument.) Name the table array: **Grade_Table.**

4. Complete the Class Grade Distribution in the range I32:I43 on the **Grade Details** worksheet. The purpose of this area is to show how many students received the grades listed in the range H32:H43. For example, how many students receive an A, A–, and so

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

on. Include a percent of total for each grade. Name the range I4:I28 Student_Grades. *Hint: This can be accomplished using the COUNTIF function if you successfully complete the VLOOKUP function in step 3. If you are unable to complete step 3, you can still complete this step using the COUNTIFS function.*

5. Add any formatting enhancements to the Grade Details worksheet that would make the worksheet easier to read and use. Consider the "Special Note" in Table 3.12 "FinalGrade Calculation".

SUMIF(S), COUNTIF(s) Naming cells and ranges

Starter File: Invoice Analysis.xlsx

Science Technologies, Inc has downloaded some raw invoice material from their accounting system. They want to evaluate salesman commissions and the length of time invoices have been outstanding. You will complete the worksheet analysis for them.

Open the Invoice Analysis files and complete the following:

In the Invoices Worksheet:

21. You must use named cells and ranges in this assignment!
22. In the cell H1 enter the date 7/1/2023 as the current date. Then name that cell CurrentDate.
23. In the cell K1 enter 4% as the commission rate. Then name that cell CommissionRate
24. In the G column calculate the days past due. (Current date – invoice date). Name the range of past due dates DaysPastDue.
25. Name the range of cells that contains the sales rep SalesRep.
26. Calculate the sales rep's commissions by multiplying the commission rate *the invoice amount
27. Name the range of cells that contains the Invoice Amounts as InvoiceAmt
28. Use a COUNT function in G106 to count the number of invoices.
29. Add totals at the bottom of the Commissions and invoice amounts columns.
30. Use conditional formatting to highlight past due invoices for than 90 days pastdue.
31. Format columns appropriately.

In the Invoice Analysis Worksheet

32. In the B column use a COUNTIF function to count the number of invoices foreach sales rep.
33. In the Commission column, use a SUMIF to total the commissions for each salesrep.
34. In the Total Amount column, use a SUMIF to total the invoices for each salesrep.
35. Create totals at the bottom of each column and format appropriately. (Hint: totals should equal the totals you created in the Invoices worksheet)
36. In the Nbr Invoices column use COUNTIFS to count the invoices in eachaging category.
37. In the Amount column use SUMIFS to total the invoices in each agingcategory.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

38. Create totals at the bottom of each column and format appropriately. (Hint: totals should equal the totals you created in the Invoices worksheet and in the SalesRep Analysis on the Invoice Analysis worksheet.
39. Add your 3-line title to the Invoice Analysis Worksheet.
40. Save your file and upload it before the due date and time.

CHAPTER SKILLS TEST

Starter File: Chapter 3 Skills Test

Difficulty: Level 2 Moderate

Answer the following questions by executing the skills on the starter file required for this test. Answer each question in the order in which it appears. If you do not know the answer, skip to the next question.

Open the starter file before you begin this test.

1. Set the Freeze Panes command so that Rows 1 and 2 and Columns A and B are locked in place while scrolling through the Investment Detail worksheet.
2. In the Investment Detail worksheet, enter an IF function into cell I3. The output of the function should be the word Gain if the Current Investment Value in cell H3 is greater than the Cost of Purchase in cell G3.
3. Otherwise, the output of the function should be the words No Gain.
4. Copy the IF function in cell I3 and paste it into the range I4:I17 using the Paste Formulas command.
5. In the Investment Detail worksheet, enter a nested IF function into cell F3. If the Dividend/Yield value in cell E3 is less than 2%, show the word Low. If the Dividend/Yield value in cell E3 is greater than or equal to 5%, show the word High. Otherwise, show the word Moderate.
6. Copy the IF function in cell F3 and paste it into the range F4:F17 using the Paste Formulas command.
7. On the Investment Detail worksheet in cell O3, use the OR function within an IF function to evaluate the Current vs. Target value. If the Current vs. Target value in cell N3 is greater than 2% or less than −2%, show the word REBAL. Otherwise, show the word OK.
8. Copy the IF function in cell O3 and paste it into the range O4:O17 using the Paste Formulas command.
9. On the Investment Detail worksheet in cell P3, use the AND function within an IF function to evaluate the Current vs. Target value and the Unrealized Gain/Loss value. If the Current vs. Target value in cell N3 is greater than 2% and if the Unrealized Gain/Loss value in cell J3 is greater than 0, show the word BUY.
10. Otherwise, show the word HOLD.
11. Copy the IF function in cell P3 and paste it into the range P4:P17 using the Paste Formulas command.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

12. On the Investment Detail worksheet, apply a conditional format to the range Q3:Q17. If the Months Owned is less than 12, change the font color to red. Otherwise, the font color should remain black.
13. On the Investment Detail worksheet, enter a VLOOKUP function in cell D3 that displays the Growth Last Year for the symbol in cell B3. The growth last year for all investments can be found in Column E on the Investment List worksheet. Your function should look for an exact match to the lookup value. Consider that this function will be copied and pasted into the range D4:D17 when defining the arguments.
14. On the Investment Detail worksheet, format the range D3:D17 to a percentage with two decimal places. Then copy the VLOOKUP function in cell D3 and paste it into the range D4:D17 using the Paste Formulas command.
15. On the Portfolio Summary worksheet, use the COUNTIF function in cell B3 to count the number of investments that match the investment type in cell A3. The function should look for and count the number of investment types in the range A3:A17 on the Investment Detail worksheet. Consider that this function will be copied and pasted into the range B4:B6 when defining the arguments.
16. Copy the COUNTIF function in cell B3 and paste it into the range B4:B6 using the Paste Formulas command.
17. On the Portfolio Summary worksheet, use the AVERAGEIF function in cell C3 to calculate the average Dividend/Yield for the investment type in cell A3. The function should calculate the average using the data in the range E3:E17 on the Investment Detail worksheet. The function should look for a match to the investment type in the range A3:A17 on the Investment Detail worksheet. Consider that this function will be copied and pasted into the range C4:C6 when defining the arguments.
18. Copy the AVERAGEIF function in cell C3 and paste it into the range C4:C6 using the Paste Formulas command.
19. On the Portfolio Summary worksheet, use the SUMIF function in cell D3 to calculate the Percent of Portfolio for the investment type in cell A3. The function should calculate the sum using the data in the range L3:L17 on the Investment Detail worksheet. The function should look for a match to the investment type in the range A3:A17 on the Investment Detail worksheet. Consider that this function will be copied and pasted into the range D4:D6 when defining the arguments.
20. Copy the SUMIF function in cell D3 and paste it into the range D4:D6 using the Paste Formulas command.
21. On the Portfolio Summary worksheet, use the HLOOKUP function to display the Portfolio Target in cell E3. The function should look for the Investment Type in cell A3 in Row 2 of the Portfolio Targets worksheet. The function should display the percentage in the Moderate row (Row 5) for each investment type. The function

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

should look for an exact match to the lookup value. Consider that this function will be copied and pasted into the range E4:E6 when defining the arguments.

22. Copy the HLOOKUP function in cell E3 and paste it into the range E4:E6 using the Paste Formulas command.
23. On the Portfolio Summary worksheet, use the COUNTIFS function in cell B10 to count the number of investments that match the investment type in cell A10 and have an unrealized gain that is greater than or equal to 20%. The function should look for and count the investment types in the range A3:A17 on the Investment Detail worksheet where the Percent Gain/Loss in the range K3:K17 is greater than or equal to 20%. Consider that this function will be copied and pasted into the range B11:B13 when defining the arguments.
24. Copy the COUNTIFS function in cell B10 and paste it into the range B11:B13 using the Paste Formulas command.
25. On the Portfolio Summary worksheet, use the SUMIFS function in cell C10 to sum the Total Unrealized Gain for the investment type in cell A10 where the unrealized gain is greater than or equal to 20%. The function should calculate the sum using the data in the range J3:J17 on the Investment Detail worksheet. The function should look for a match to the investment type in the range A3:A17 on the Investment Detail worksheet where the Percent Gain/Loss in the range K3:K17 is greater than or equal to 20%. Consider that this function will be copied and pasted into the range C11:C13 when defining the arguments.
26. Copy the SUMIFS function in cell C10 and paste it into the range C11:C13 using the Paste Formulas command.
27. On the Portfolio Summary worksheet, use the AVERAGEIFS function in cell D10 to calculate the average Dividend/Yield for the investment type in cell A10 where the unrealized gain is greater than or equal to 20%. The function should calculate the average using the data in the range E3:E17 on the Investment Detail worksheet. The function should look for a match to the investment type in the range A3:A17 on the Investment Detail worksheet where the Percent Gain/Loss in the range K3:K17 is greater than or equal to 20%. Consider that this function will be copied and pasted into the range D11:D13 when defining the arguments.
28. Copy the AVERAGEIFS function in cell D10 and paste it into the range D11:D13 using the Paste Formulas command.
29. Save the workbook by adding your name in front of the current workbook name (i.e.,
30. "your name Chapter 3 Skills Test").
31. Close the workbook and Excel.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Chapter 4

Presenting Data with Charts

Chapter 1 "Fundamental Skills" provided a brief introduction to creating charts in Excel. This chapter provides more details for enhancing the appearance of your charts and addresses how to choose the best chart type for your data.

One of the most important things to consider when using charts in Excel is that they are intended to be used for communicating an idea to an audience. Your audience can be reading your charts in a written document or listening to you in a live presentation. In fact, Excel charts are often imported or pasted into Word documents or PowerPoint slides. This serves the purpose of communicating ideas to an audience. Although there are no rules set in stone for using specific charts for certain data types, some chart types are designed to communicate certain messages better than others. This chapter explores numerous charts that can be used for a variety of purposes. In addition, we will examine formatting charts and using those charts in Word and PowerPoint documents.

4.1 Choosing a Chart Type

LEARNING OBJECTIVES
1. Decide which chart type to use.
2. Construct a line chart to show a time series trend.
3. Learn how to adjust the Y axis scale.
4. Construct a line chart to present a comparison of two trends.
5. Learn how to use a column chart to show a frequency distribution.
6. Create a separate chart sheet for a chart embedded in a worksheet.
7. Construct a column chart that compares two frequency distributions.
8. Learn how to use a pie chart to show the percent of total for a dataset.
9. Construct a stacked column chart to show how a percent of total changes over time.

This section reviews the most used Excel chart types. To demonstrate the variety of chart types available in Excel, it is necessary to use a variety of data sets. Therefore, instead of addressing a specific theme, we will use a variety of themes. This is necessary not only to demonstrate the construction of charts but also to explain how to choose the right type of chart given your data and the idea you intend to communicate.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Before we begin, let's review a few key points you need to consider before creating any chart in Excel.

- The first is identifying your idea or message. It is important to keep in mind that the primary purpose of a chart is to present quantitative information to an audience. Therefore, you must first decide what message or idea you wish to present. This is critical in helping you select specific data from a worksheet that will be used in a chart. Throughout this chapter, we will reinforce the intended message first before creating each chart.
- The second key point is selecting the right chart type. The chart type you select will depend on the data you have and the message you intend to communicate. The table below describes how each chart type is used.

Table 4.1 How to choose a chart type:

Line Chart:	The line chart is one of the most frequently used chart types because it is used to show trends over time. If your data is depicting changes over time, use a line chart.
Column Chart:	Column charts are typically used to compare several items in a specific range of values. Column charts should be used when comparing a single category of data between individual sub-items, such as, for example, when comparing revenue between products.
Clustered Column Chart:	A clustered column chart can be used when comparing multiple categories of data within individual sub-items as well as between sub-items. For instance, you can use a clustered column chart to compare sales for each quarter within each region, as well as between regions.
Stacked Column Chart:	A stacked column chart allows you to compare items in a specific range of values as well as show the relationship of the individual sub-items with the whole. For instance, a stacked column chart can show not only the overall revenue for each year, but also the proportion of the total revenue made up by each region.
Pie Chart:	A frequently used chart is the pie chart. A pie chart represents the distribution or proportion of each data item over a total value (represented by the overall pie). A pie chart can only be used for one data series. i.e. sales by product for March or total sales for 2017 by product, etc.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Combo Chart:	A combo chart is a visualization that combines two or more chart types into a single chart. Combination charts are an ideal choice when you want to compare two categories of each individual sub-item that would otherwise not present good visual data. They are commonly used to create visualizations that show the difference between targets versus actual results.

- The third key point is identifying the values that should appear on the X and Y axes. One of the ways to identify which values belong on the X and Y axes is to sketch the chart on paper first. If you can visualize what your chart is supposed to look like, you will have an easier time using Excel to construct an effective chart that accurately communicates your message. Table 4.2 "Key Steps before Constructing an Excel Chart" provides a summary of these points.
- The fourth key point is determining how you can best label your chart to clearly explain to your audience the meaning of the message you are presenting. Your reader should be able to understand what the chart is presenting without having it explained to them.

Integrity Check - Carefully Select Data When Creating a Chart
Just because you have data in a worksheet does not mean it must all be placed onto a chart. When creating a chart, it is common for only specific data points to be used. To determine what data should be used when creating a chart, you must first identify the message or idea that you want to communicate to an audience.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Table 4.2 Key Steps before Constructing an Excel Chart

Step	Description
1. Define your message.	Identify the main idea you are trying to communicate to an audience. If there is no main point or important message that can be revealed by a chart, you might want to question the necessity of creating a chart.
2. Identify the data you need.	Once you have a clear message, identify the data on a worksheet that you will need to construct a chart. In some cases, you may need to create formulas or consolidate items into broader categories.
3. Select a chart type.	The type of chart you select will depend on the message you are communicating and the data you are using.
4. Identify the values for the X and Y axes.	After you have selected a chart type, you may find that drawing a sketch is helpful in identifying which values should be on the X and Y axes. (The X axis is horizontal, and the Y axis is vertical.)

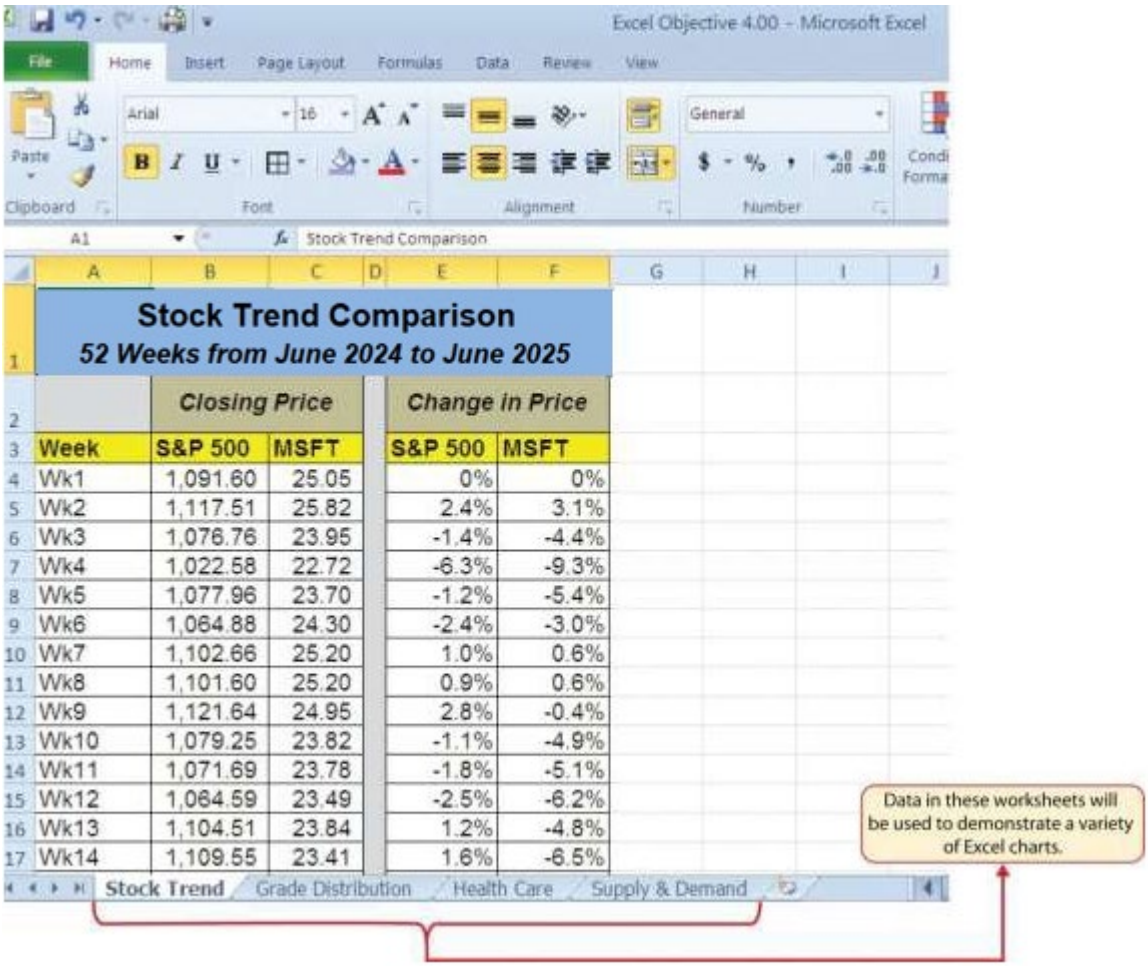
Line Chart

Follow-along file: Excel Objective 4.00

The first chart we will demonstrate is a line chart. Figure 4.1 "52 Week Data for the S&P 500 and Microsoft" shows part of the data that will be used to create two-line charts. The first line chart will show the trend of the S&P 500 stock index. This is an aggregate price index of five hundred of the largest publicly traded companies. This chart will be used to communicate a simple message: to show how the index has performed over a fifty-two-week period. We can use this chart in a presentation to show whether stock prices have been increasing, decreasing, or remaining constant over the *designated period*.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.1 52 Week Data for the S&P 500 and Microsoft



Before we create the line chart, it is important to identify why it is an appropriate chart type given the message we wish to communicate and the data we have. When presenting the trend for any data over a designated time period, the most commonly used chart type is the line chart. A column chart could be used but is typically used to show comparative data rather than data over time.

Given the four steps outlined above, let's determine how we will set up our line chart.

- **Define the message**: Our line chart will show the closing price for the S&P 500 over a 52-week period.
- **Define the data needed**: The data needed is the week and the closing price of the S&P 500.
- **Select a chart type**. Since we are looking at the changes in closing price over a designated time period we will use a line chart which most clearly conveys changes over time.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

- **Identify the values on the X and Y axis**. We will put the week number on the X axis because the audience is used to see a time-line progress horizontally and the closing price on the Y axis because it will show the price changes at each point in time.

The following steps explain how to construct this line chart:

1. Highlight the range A3:B55 on the **Stock Trend** worksheet. *Note: Do not select more data than that needed to create a specific chart.*
2. Click the Insert tab of the Ribbon. *Note: When constructing a chart, you want to have the data labels included. The data labels in A3:B3 will be displayed on the chart and will help identify the data being presented*.
3. Click the Line button in the Charts group of commands (see Figure 4.2 "Selecting the Basic Line Chart").
4. Click the first option from the list, which is a basic line chart. This adds, or embeds, the line chart to the worksheet, as shown in Figure 4.3 "Embedded Line Chart in the Stock Trend Worksheet".

Figure 4.2 Selecting the Basic Line Chart

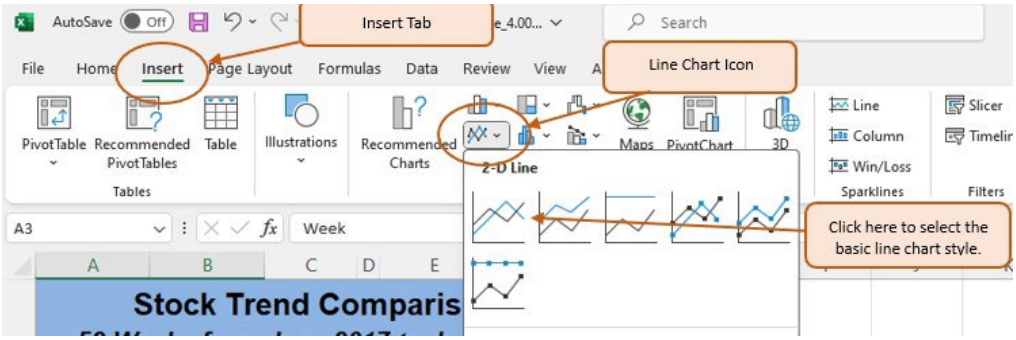
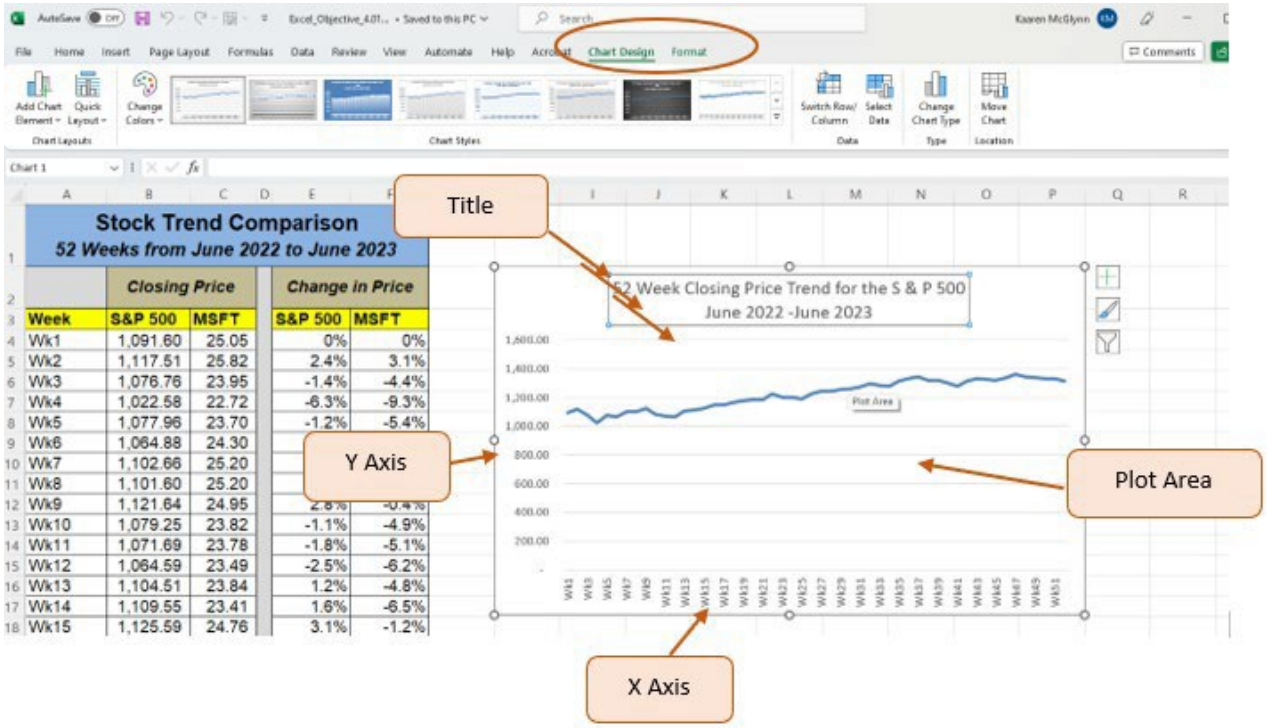


Figure 4.3 "Embedded Line Chart in the Stock Trend Worksheet" shows the embedded line chart in the Stock Trend worksheet. Notice that two additional tabs, or contextual tabs, are added to the Ribbon. We will demonstrate the commands in these tabs throughout this chapter. These tabs appear only when the chart is activated.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.3 Embedded Line Chart in the Stock Trend Worksheet



The embedded chart may not be placed in an ideal location on the worksheet and may be covering several cell locations that contain data.

The following steps demonstrate common adjustments that are made when working with embedded charts:

1. **Moving a chart:** Click and drag the upper left corner of the chart to the center of cell H2.
2. **Resizing a chart:** Place the mouse pointer over the left middle sizing handle, hold down the ALT key on your keyboard, and click and drag the chart so it "snaps" to the left side of Column H. Repeat step 2 to resize the chart so the top "snaps" to the top of Row 2, the bottom "snaps" to the bottom of Row 17, and the right side "snaps" to the right side of Column P.
3. **Adjusting the chart title:** Click the chart title once. In the formula bar type: **52 Week Closing Price Trend for the S&P 500**. Hold the Alt key down and press Enter. This will add a second row to your title. Type June 2022 to June 2023. Click Enter.
4. **Removing the legend: (**If the chart you just inserted does not contain a legend, skip this step.) Because the chart contains only one data series (the Closing Price) we will remove the legend because it is unnecessary. Click the legend once and press the DELETE key on your keyboard. This removes the legend from the chart. Once you remove the legend, the plot area automatically expands.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.4 "Line Chart Moved and Resized" shows the line chart after it is moved and resized. You can also see that the title of the chart has been edited to read *52 Week Trend for the S&P 500*. Also notice that the sizing handles do not appear around the perimeter of the chart. This is because the chart has been deactivated. To activate the chart, click anywhere inside the chart perimeter.

Figure 4.4 Line Chart Moved and Resized

Skill Refresher: Inserting a Line Chart

1. Highlight a range of cells that contain data that will be used to create the chart.
2. Click the Insert tab of the Ribbon.
3. Click the Line button in the Charts group.
4. Select a format option from the Line Chart drop-down menu.

Adjusting the Y Axis Scale

Follow-along file: Continue with Excel Objective 4.00. (Use file Excel Objective 4.01 if starting here.)

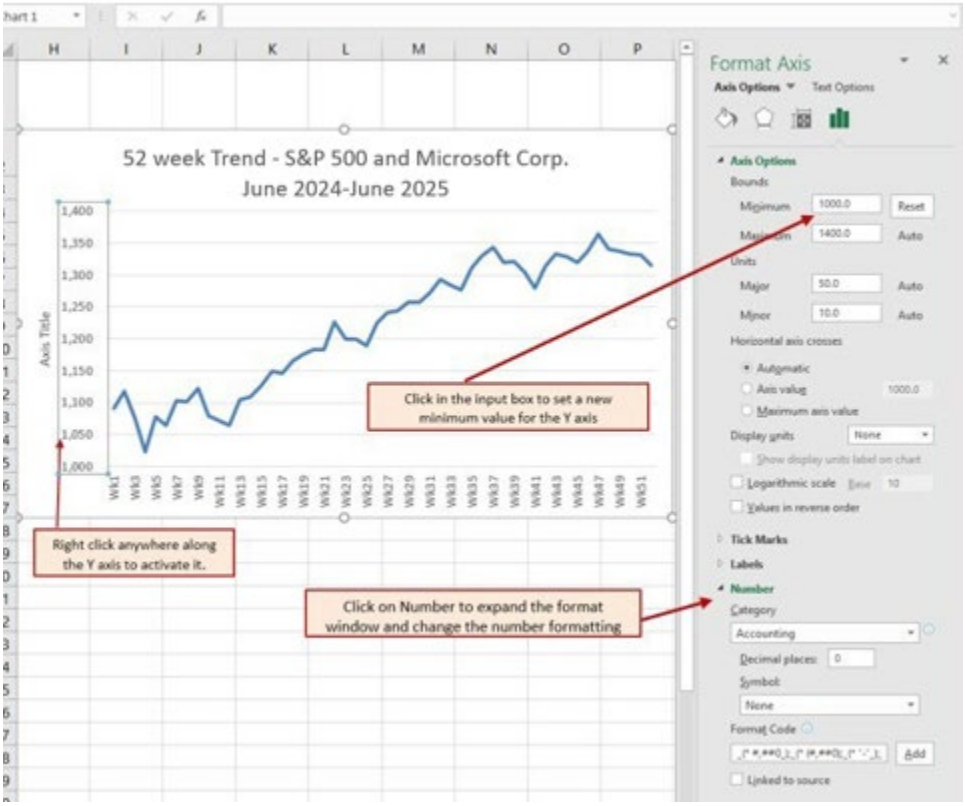
After creating an Excel chart, you may find it necessary to adjust the scale of the Y axis. Excel automatically sets the maximum value for the Y axis based on the data used to create the chart. However, the minimum value is usually set to zero. Depending on the data you are using to create the chart, setting the minimum value to zero can substantially minimize the graphical presentation of a trend. For example, the trend shown in Figure 4.4 "Line Chart Moved and Resized" appears to be increasing slightly. However, the S&P 500 increased by over 20% during this period, which is substantial. The presentation of this trend can be improved if the minimum value started at eight hundred. While it is certainly

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

possible for the S&P 500 to fall below eight hundred, it is most likely remote. The following steps explain how to make this adjustment to the Y axis:

1. Right click anywhere on the Y axis on the *52 Week Trend for the S&P 500 line* chart (**Stock Trend** worksheet) and select Format Axis.
2. The Format Axis dialog box will appear on the right of your worksheet.

Figure 4.4 Format Axis Dialogue Box


52 week Trend - S&P 500 and Microsoft Corp.
June 2024-June 2025
Axis Title
Format Axis
Axis Options
Text Options
Click in the input box to set a new minimum value for the Y axis
Right click anywhere along the Y axis to activate it.
Click on Number to expand the format window and change the number formatting

3. In the Axis Options Window, click in the Minimum box and change the minimum value to be displayed on the Y axis from 0 to 1000. This will eliminate the white space on your chart that adds no visual value. Press the tab key to display the change in your chart.
4. Because we are dealing in whole numbers, we will adjust the values on the Y axis to display with no decimal places. Click on the Number label to expand the Number menu. Under Decimal places, change the value from 2 to 0

Figure 4.6 "Adjusted Y Axis for the S&P 500 Chart" shows the change in the presentation of the trendline. Notice that with the Y axis starting at 1,000, the trend for the S&P 500 is more pronounced and reflects the substantial increase over the 52-week period. This adjustment makes it easier for the audience to see the magnitude of the trend.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.6 Adjusted Y Axis for the S&P 500 Chart

Skill Refresher - Adjusting the Y Axis Scale

1. Right click anywhere along the Y axis to activate it and select Format Axis from the drop-down quick menu.
2. In the Format Axis dialog box, click in the input box next to the desired axis option and then type the new scale value.
3. Click on the Number format to expand the Number format options. Change the number of decimal places, or number format to better convey your information.
4. Click the X button at the top of the Format Axis dialog box.

Line Chart 2: Trend Comparisons Over Time

Follow-along file: Continue with Excel Objective 4.00. (Use file Excel Objective 4.02 if starting here.)

We will now create a second line chart using the data in the **Stock Trend** worksheet. The purpose of this chart is to compare two trends:

- the change in value for the S&P 500 and
- the change in value of a single stock - Microsoft common stock.

Chapter 3 "Logical and Lookup Functions" presented a personal investment portfolio where the investments were compared to a benchmark. The S&P 500 is a benchmark that is commonly used to judge the performance of individual stocks. The purpose and message

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

of this chart is to show whether Microsoft is performing better or worse than the S&P 500 index. This type of analysis can be used as a visual tool to determine whether a stock should be sold, purchased, or held.

Before creating the chart to compare the S&P 500 and Microsoft, it is important to review the data in the range E4:F55 on the **Stock Trend** worksheet. For a simple line chart, we cannot use the price data for Microsoft and the S&P 500 because the values are not comparable. That is, the data for Microsoft is in a range of $22.00 to $28.00, but the data for the S&P 500 is in a range of $1,022 to $1,363. If we used these values to create a chart, we would not be able to see any substantial change in the trend for either the S&P 500 or Microsoft. Therefore, formulas were used to calculate the percent change in value for the S&P 500 and Microsoft for each week. For example, looking at cells E5 and F5 on the **Stock Trend** worksheet, you see that the S&P 500 increased 2.4% in week 2, whereas Microsoft increased 3.1%. The percent change calculations now provide an appropriate method of comparison. This is a very important step to consider when comparing trends.

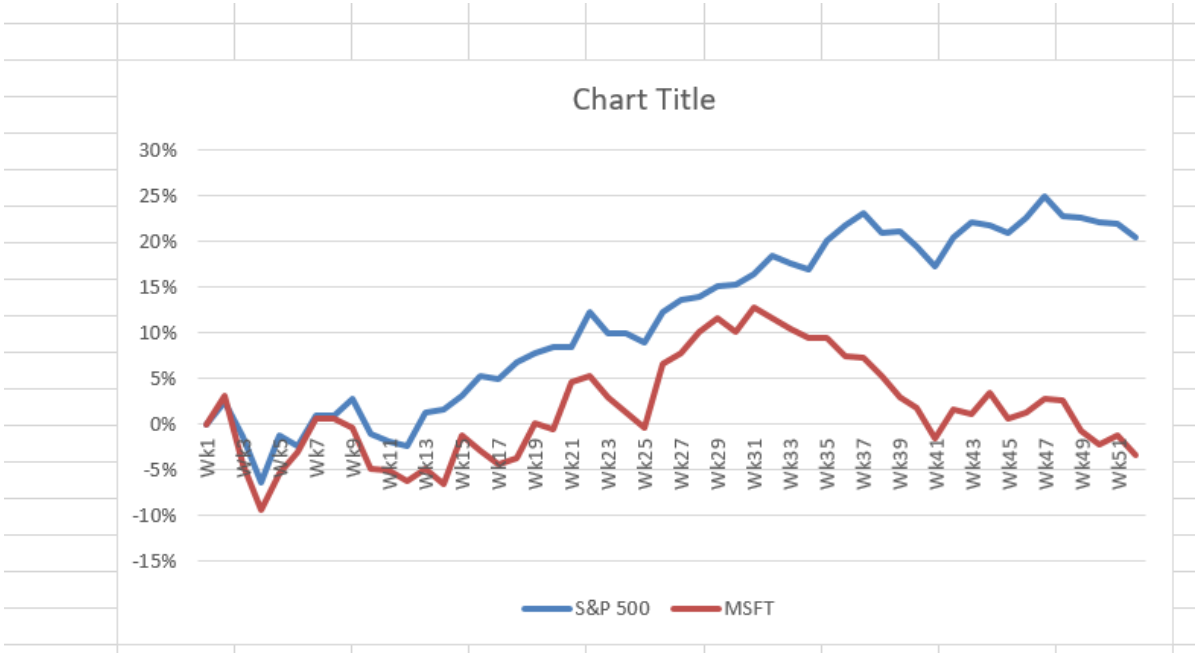
The construction of this second line chart will be like the first line chart. The X axis will be the 52 weeks in the range A4:A55. However, the Y axis will be the percentages in the range E4:F55. This creates a problem because Columns B, C, and D will not be used in this chart. Therefore, we cannot simply highlight one contiguous range of cells to create the chart. In this chapter, we will demonstrate two options for charting data that is not in a contiguous range. The following steps demonstrate the first option:

1. Highlight the range A3:A55 on the **Stock Trend** worksheet.
2. Hold down the CTRL key on your keyboard and highlight the range E3:F55.
3. Click the Insert tab of the Ribbon.
4. Click the Line button in the Charts group of commands.
5. Click the first option from the list, which is a basic line chart.

Figure 4.7 "Trend Comparison Line Chart" shows the appearance of the line chart comparing the S&P 500 and Microsoft before it is moved and resized.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

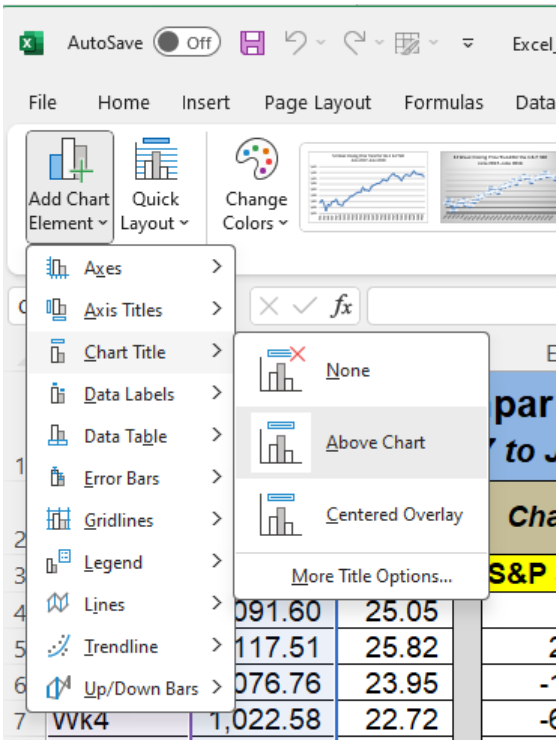
Figure 4.7 Trend Comparison Line Chart



6. Move the chart so the upper left corner is in the middle of cell H20.
7. Resize the chart so the left side is locked to the left side of Column H, the right side is locked to the right side of Column P, the top is locked to the top of Row 20, and the bottom is locked to the bottom of Row 35.
8. Click the Design tab in the Chart Tools section of the Ribbon.
9. Click the drop-down next to the Add Chart Element. Select Chart Title from the drop-down list. Chart. Because there is a lot of white space above the line chart we will select the Above Chart option from the drop-down list (see Figure 4.8 "Adding a Title to a Chart"). This adds a generic title above the plot area of the chart.
10. While the title box is selected, click in the formula bar and type **52 Week Trend - S&P 500 and Microsoft Comparison,** alt Enter to add a new row to the chart title and then type June 2022 – June 2023. When you hit enter the new chart title will appear in the Chart Title box.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.8 Adding a Title to a Chart

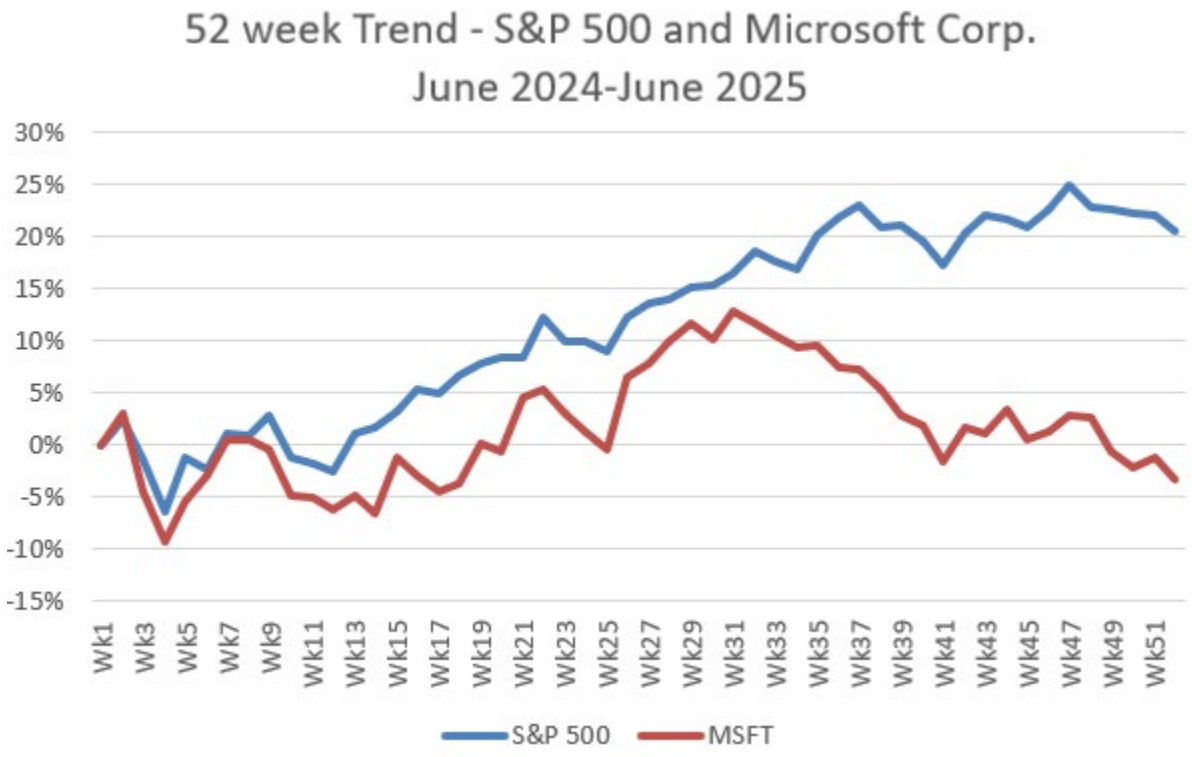


11. To reposition the X axis labels so that the trend lines are not overlapping the axis and hiding the weeks, click anywhere on the weeks to activate the X axis. Right click and select Format Axis from the drop-down menu. Click on Labels, then Label Position. Choose Low to position the weeks below the lowest value in the chart.

Figure 4.9 "Final Trend Comparison Line Chart" shows that Microsoft has not performed as well as the S&P 500 benchmark. From week 31 to week 52, Microsoft is showing a significant decline compared to the S&P 500, which continues to grow. What makes this chart effective is that an audience can quickly see how Microsoft compares with the S&P 500 over the 52-week period.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.9 Final Trend Comparison Line Chart



Integrity Check - Comparing Trends with Incompatible Values

When creating a chart to compare the trends of two or more data series, the values for each data series must be compatible. In other words, the values for each data series must be within a reasonable range for an effective comparison to be made. If the variance between the values in your data series is never less than a multiple of 2 (i.e., 500 × 2 = 1000 or 1000 ÷ 2 = 500), calculate the percent change for each point in time on your worksheet. The percent change must be calculated with respect to the *first data point* for each series. Then create your chart using the percentages instead of the actual values for each data series.

Column Chart 1: Frequency Distribution

Follow-along file: Continue with Excel Objective 4.00. (Use file Excel Objective 4.03 if starting here.)

A professor at the school wants to chart the performance of his students in his class based on the grades earned during the class. He decides to use a column chart to show the results because column charts are typically used to compare several items, (in this case the grade distribution,) over a specific range of values, (the number of students in his class.). Column

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

charts should be used when comparing a single category of data between individual sub-items.

In column charts, categories are typically organized along the horizontal axis and values along the vertical axis. For example, in Chapter 1 "Fundamental Skills" we showed a sales trend over a twelve-month period.

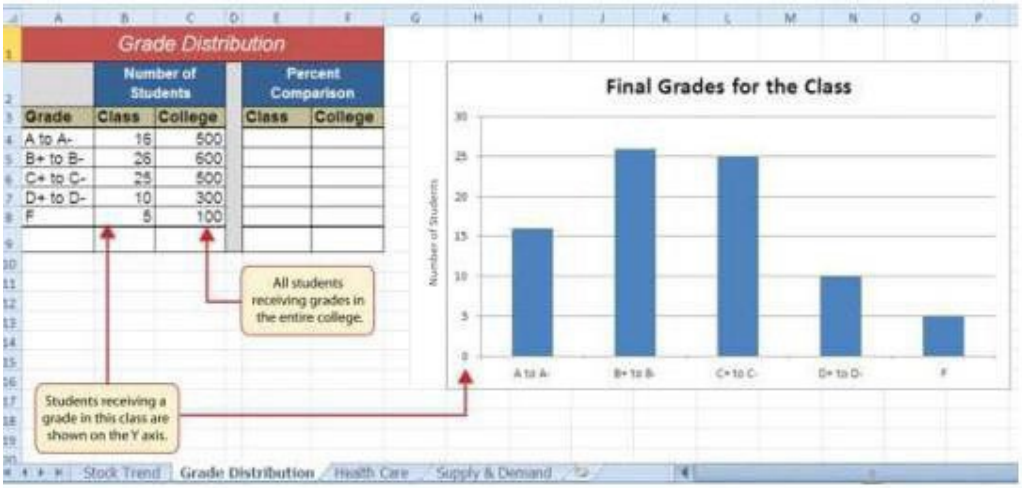
Another common use for column charts is frequency distributions. A frequency distribution shows the number of occurrences by established categories. For example, a common frequency distribution used in most academic institutions is a grade distribution. A grade distribution shows the number of students that achieve each level of a typical grading scale (A, A–, B+, B, etc.). The **Grade Distribution** worksheet contains the final grades for the professor's academic class. To show the grade frequency distribution, the numbers of students appear on the Y axis and the grade categories appear on the X axis. The following steps explain how to create this chart:

1. Highlight the range A3:B8 on the **Grade Distribution** worksheet. Column B shows the number of students that achieved a grade within the grade category shown in Column A.
2. Click the Column button in the Charts group section on the Insert tab of the Ribbon. Select the first format from the drop-down list of options, which is the Clustered Column format.
3. Click and drag the chart so the upper left corner is in the middle of cell H2.
4. Resize the chart so the left side is locked to the left side of Column H, the right side is locked to the right side of Column P, the top is locked to the top of Row 2, and the bottom is locked to the bottom of Row 16.
5. From the Chart Tools Design ribbon add a Y axis title to explain what the Y axis is referring to. Click the drop-down arrow next to Add a Chart Element and select Axis Titles, then select Primary Vertical Axis. While the axis title is still selected, click in the Formula bar and type **Number of Students.** Then click Enter.
6. Click the title of the chart to activate the title box.
7. In the formula bar type the following in front of the word *Class*: **Final Grades for the Class**.
8. Click any cell location on the **Grade Distribution** worksheet to deactivate the chart.

Figure 4.10 "Grade Frequency Distribution Chart" shows the completed grade frequency distribution chart. By looking at the chart, you can immediately see that the greatest number of students earned a final grade in the *B+ to B–* or the *C+ to C–* categories.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.10 Grade Frequency Distribution Chart



Why?
Column Chart vs. Bar Chart When using charts to show frequency distributions, the difference between a column chart and a bar chart is really a matter of preference. Both are very effective in showing frequency distributions. However, if you are showing a trend over a period of time, a column chart is preferred over a bar chart. This is because a period of time is typically shown horizontally, with the oldest date on the far left and the newest date on the far right. Therefore, the descriptive categories for the chart would have to fall on the X axis, which is the configuration of a column chart. On a bar chart, the descriptive categories are displayed vertically along the Y axis.

Moving a Chart to a Chart Sheet

Follow-along file: Continue with Excel Objective 4.00. (Use file Excel Objective 4.04 if starting here.)

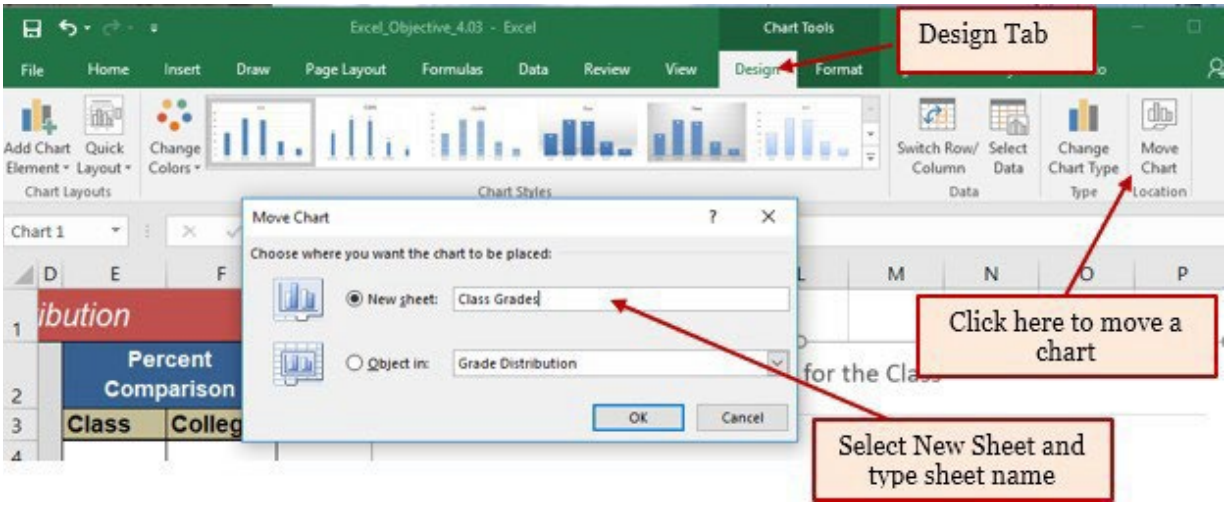
The charts we have created up to this point have been added to, or embedded in, an existing worksheet. Charts can also be placed in a dedicated worksheet called a chart sheet. It is called a chart sheet because it can contain only an Excel chart. Chart sheets are useful if you need to create several charts using the data in a single worksheet. If you embed several charts in one worksheet, it can be cumbersome to navigate and browse through the charts. It is easier to browse through charts when they are moved to a chart sheet because a separate sheet tab is added to the workbook for each chart.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

The following steps explain how to move the grade frequency distribution chart to a dedicated chart sheet:

1. Click anywhere on the Final Grades for the Class chart on the **Grade Distribution** worksheet.
2. Click the Move Chart button in the Design tab of the Chart Tools set of commands. This opens the Move Chart dialog box. You can use this dialog box to move the chart to a different worksheet or create a dedicated chart sheet.
3. Click the New sheet option on the Move Chart dialog box.
4. The entry in the input box for assigning a name to the chart sheet tab should automatically be highlighted once you click the New sheet option (see Figure 4.11 "Moving a Chart to a Chart Sheet"). Type Class Grades. This replaces the generic name in the input box.
5. Click the OK button at the bottom of the Move Chart dialog box. This adds a new chart sheet to the workbook with the name *Class Grades*.

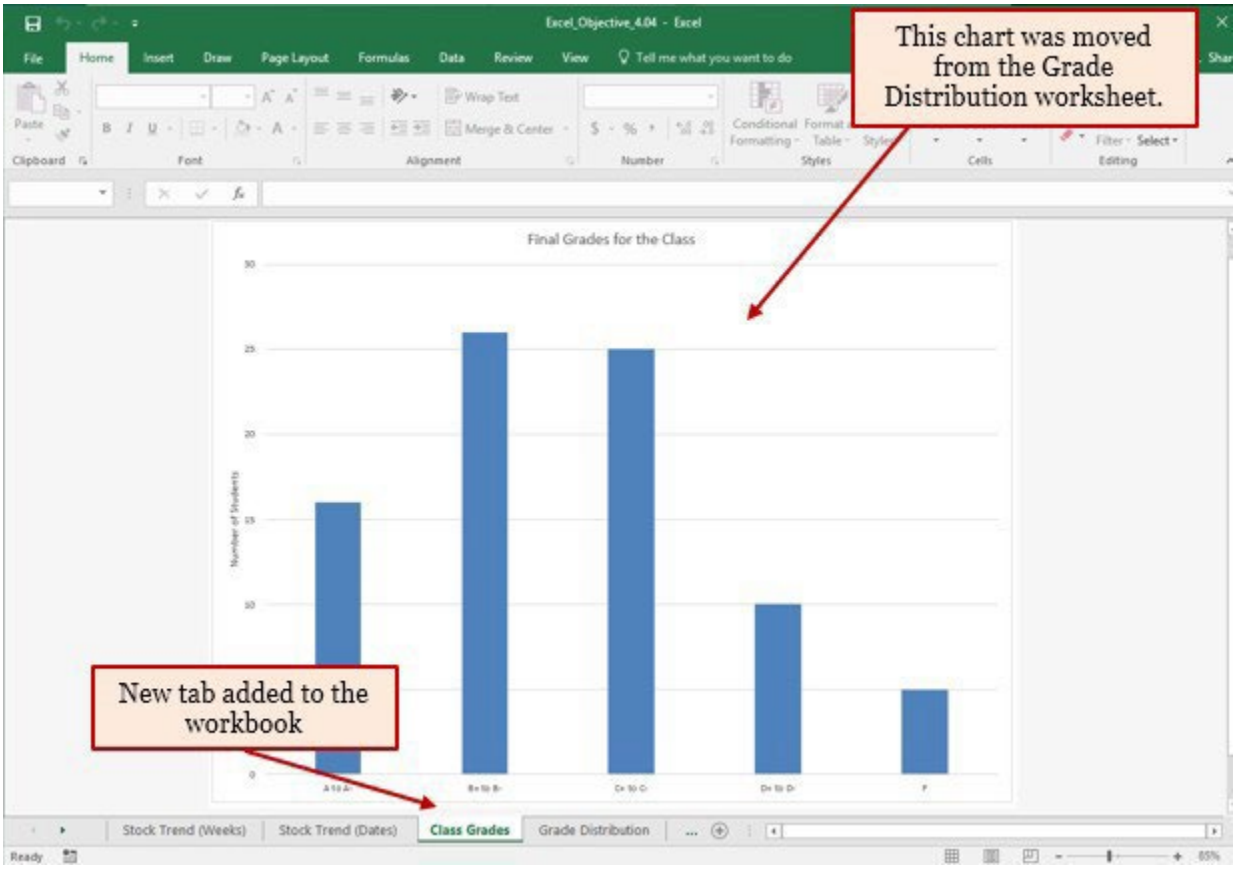
Figure 4.11 Moving a Chart to a Chart Sheet



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.12 "Chart Sheet Added to the Workbook" shows the Final Grades for the Class column chart in a separate chart sheet. Notice the new sheet tab added to the workbook matches the tab name entered into the Move Chart dialog box. Since the chart is moved to a separate chart sheet, it no longer is displayed in the **Grade Distribution** worksheet.

Figure 4.12 Chart Sheet Added to the Workbook


This chart was moved from the Grade Distribution worksheet.
Final Grades for the Class
New tab added to the workbook
Stock Trend (Weeks)
Stock Trend (Dates)
Class Grades
Grade Distribution

Clustered Column Chart: Frequency Comparison

Follow-along file: Continue with Excel Objective 4.00. (Use file Excel Objective 4.05 if starting here.)

Next, the professor would like to see how the students in his class students compared to all the students taking the course at the school. We will create a second column chart to show a comparison between two frequency distributions. Column C on the **Grade Distribution** worksheet contains data showing the number of students who received grades within each category for the entire college. We will use a clustered column chart to compare the grade distribution for the class (Column B) with the overall grade distribution for the college (Column C).

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

However, since the number of students in the class is significantly different from the total number of students in the college, we must calculate percentages to make an effective comparison. The following steps explain how to calculate the percentages:

1. Highlight the range B9:C9 on the **Grade Distribution** worksheet.
2. Click the AutoSum button in the Editing group of commands on the Home tab of the Ribbon. This automatically adds SUM functions that sum the values in the range B4:B8 and C4:C8.
3. Activate cell E4 on the **Grade Distribution** worksheet.
4. Enter a formula that divides the value in cell B4 by the total in cell B9. Add an absolute reference to cell B9 in the formula *=B4/$B$9*.
5. Copy the formula in cell E4 and paste it into the range E5:E8 using the Paste Formulas command.
6. Activate cell F4 on the **Grade Distribution** worksheet.
7. Enter a formula that divides the value in cell C4 by the total in cell C9. Add an absolute reference to cell C9 in the formula *=C4/$C$9*.
8. Copy the formula in cell F4 and paste it into the range F5:F8 using the Paste Formulas command.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.13 Completed Grade Distribution Percentages

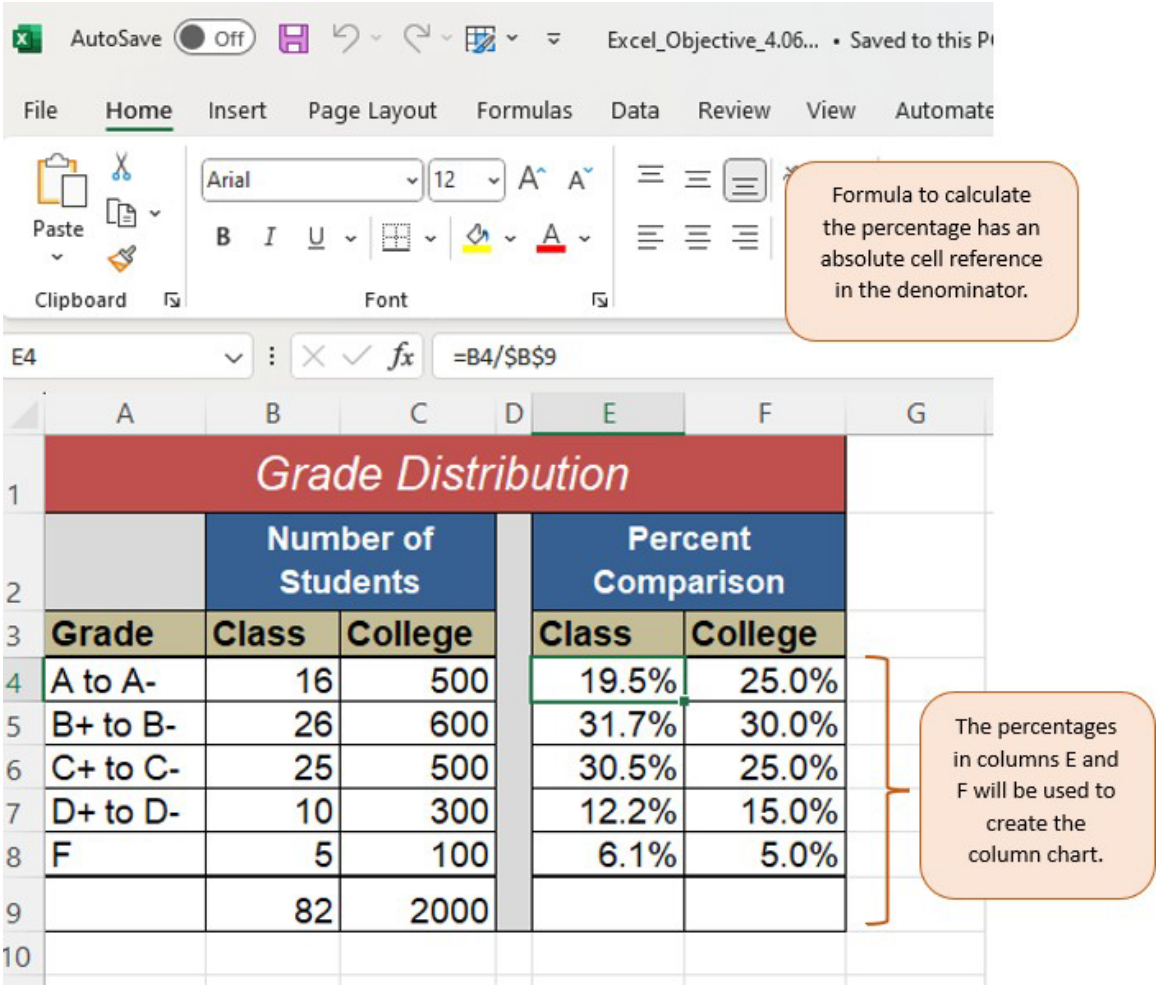

AutoSave Off
Excel_Objective_4.06... • Saved to this P
File Home Insert Page Layout Formulas Data Review View Automate
Paste
Clipboard
Arial 12
Font
Formula to calculate the percentage has an absolute cell reference in the denominator.
E4
=B4/$B$9
Grade Distribution
Number of Students
Percent Comparison
Grade Class College Class College
A to A- 16 500 19.5% 25.0%
B+ to B- 26 600 31.7% 30.0%
C+ to C- 25 500 30.5% 25.0%
D+ to D- 10 300 12.2% 15.0%
F 5 100 6.1% 5.0%
82 2000
The percentages in columns E and F will be used to create the column chart.

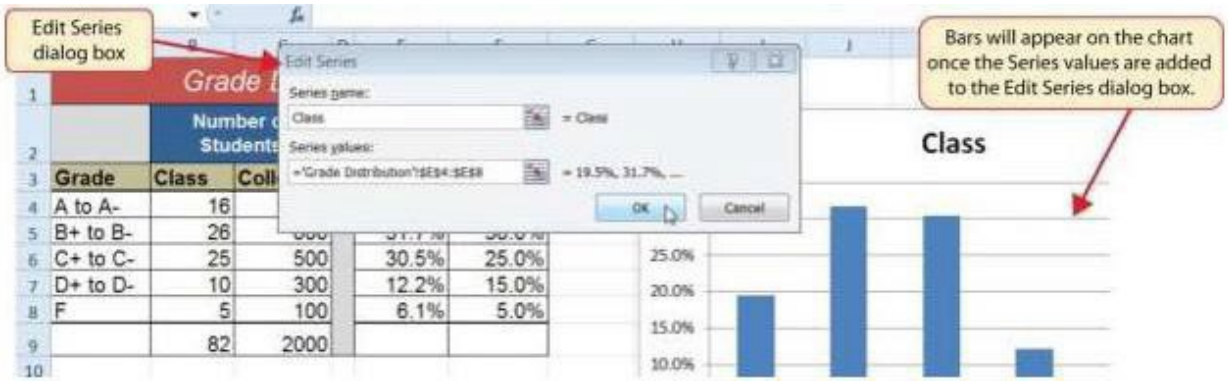
Figure 4.13 "Completed Grade Distribution Percentages" shows the completed percentages added to the **Grade Distribution** worksheet. The column chart uses the grade categories in the range A4:A8 on the X axis and the percentages in the range E4:F8 on the Y axis. Like the trend comparison line chart, this chart uses data that is not in a contiguous range. This method is more cumbersome then the first method presented but provides an excellent learning example of how to edit your chart data. The following steps explain a second method for creating charts with data that is not in a contiguous range:

1. Activate cell H2 on the **Grade Distribution** worksheet. It is important to note that this is a blank cell that is not adjacent to any data on the worksheet.
2. Click the Insert tab of the Ribbon.
3. Click the Column button in the Charts group of commands. Select the first option from the drop-down list of chart formats, which is the Clustered Column. This adds a blank chart to the worksheet.
4. Click and drag the blank chart so the upper left corner is in the middle of cell H2.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

5. Resize the blank chart so the left side is locked to the left side of Column H, the right side is locked to the right side of Column P, the top is locked to the top of Row 2, and the bottom is locked to the bottom of Row 16.
6. Click the Select Data button in the Design tab of the Chart Tools section of the Ribbon. This opens the Select Data Source dialog box.
7. Click the Add button on the Select Data Source dialog box. This opens the Edit Series dialog box.
8. In the Series name input box on the Edit Series dialog box, type the word **Class**.
9. Press the TAB key on your keyboard to advance to the Series values input box on the Edit Series dialog box.
10. Highlight the range E4:E8 on the **Grade Distribution** worksheet. This automatically adds the range to the Series values input box. You also see bars added to the column chart (see Figure 4.14 "Completed Data Series for the Class Grade Distribution").
11. Click the OK button on the Edit Series dialog box.

Figure 4.14 Completed Data Series for the Class Grade Distribution

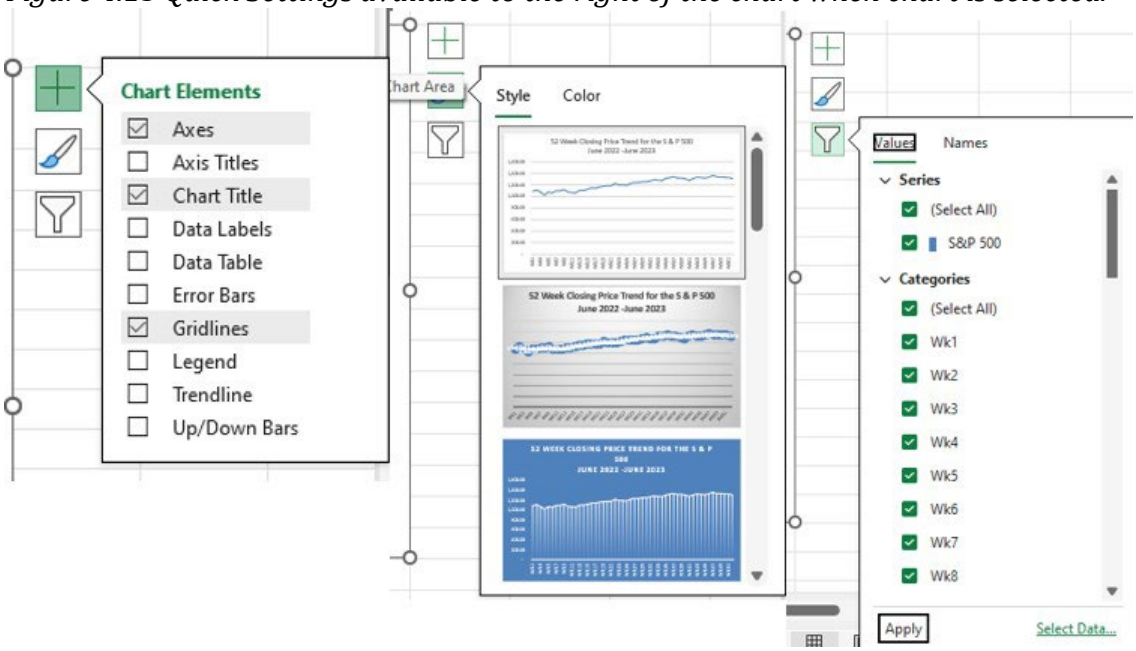


12. Click the Add button on the Select Data Source dialog box.
13. In the Series name input box on the Edit Series dialog box, type the word **College**.
14. Press the TAB key on your keyboard to advance to the Series values input box on the Edit Series dialog box.
15. Highlight the range F4:F8 on the **Grade Distribution** worksheet. This automatically adds the range to the Series values input box. You also see bars added to the column chart.
16. Click the OK button on the Edit Series dialog box.
17. Click the Edit button on the right side of the Select Data Source dialog box under the Horizontal (Category) Axis Labels section. This is used to define the labels that will appear on the X axis of the chart and opens the Axis Labels dialog box.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

18. Highlight the range A4:A8 on the **Grade Distribution** worksheet. This adds the range to the Axis Labels dialog box, and the labels appear on the X axis on the column chart.
19. Click the OK button on the Axis Labels dialog box.
20. Click the OK button on the Select Data Source dialog box.

Figure 4.15 Quick Settings available to the right of the chart when chart is selected.

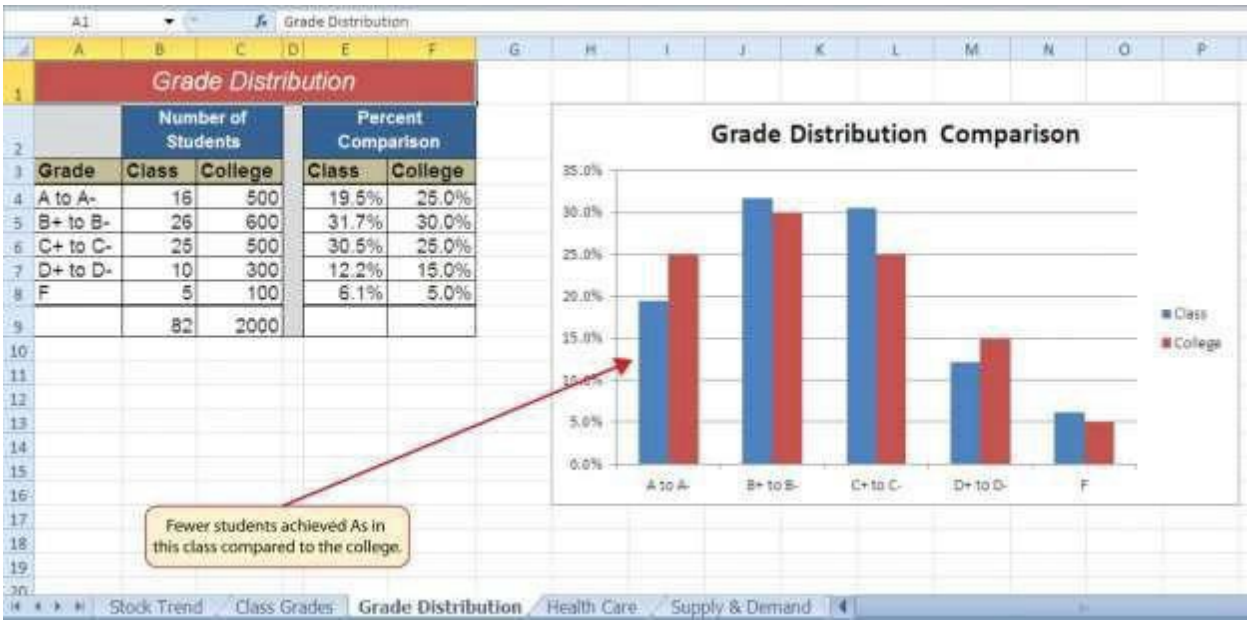


21. Click the drop-down next to the Add Chart Element. Select Chart Title from the drop-down list. Chart. Because there is a lot of white space above the line chart, we will select the Above Chart option from the drop-down list (see Figure 4.8 "Adding a Title to a Chart"). This adds a generic title above the plot area of the chart.
22. Click in the text box containing the chart title. Delete the generic chart title and replace it with the following: **Grade Distribution Comparison**.
23. From the Add Chart Element drop-down, select Legend, Bottom. This places the legend below the chart which does not compress the chart size as much as if it were placed on the sides.

Figure 4.16 "Completed Grade Distribution Column Chart" shows the final appearance of the clustered column chart. The clustered column chart is an appropriate type for this data because there are fewer than twenty data points and we can easily see the comparison for each category. An audience can quickly see that the class issued fewer A's compared to the college. However, the class had more B's and C's compared with the college population.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.16 Completed Grade Distribution Column Chart



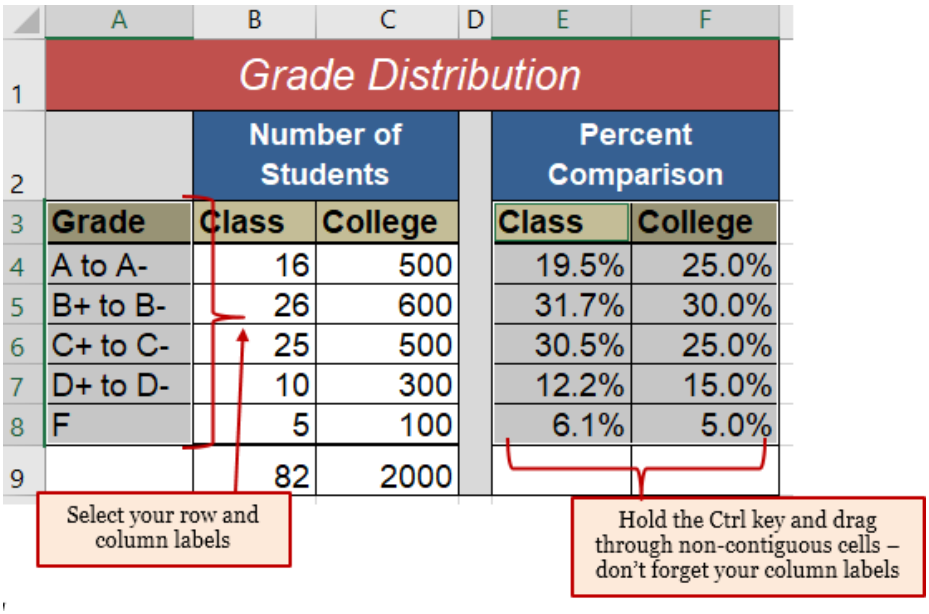
Selecting Non-Contiguous Ranges:

The previous steps walked you through how to create a chart "from scratch" by building all the data series within the Select Data Source dialog box. A quicker method to build a chart using non-contiguous ranges is to select the first range, typically the row with labels, hold down the Ctrl key and select any other cells you want to chart.

Integrity Check - Too Many Bars on a Column Chart?
Although there is no specific limit for the number of bars you should use on a column chart, a general rule of thumb is twenty bars or less. Figure 4.17 "Poor Use of a Column Chart" contains a total of thirty-two bars. This is considered a poor use of a column chart because it is difficult to identify meaningful trends or comparisons. The data used to create this chart might be better used in two or three different column charts, each with a distinct idea or message.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

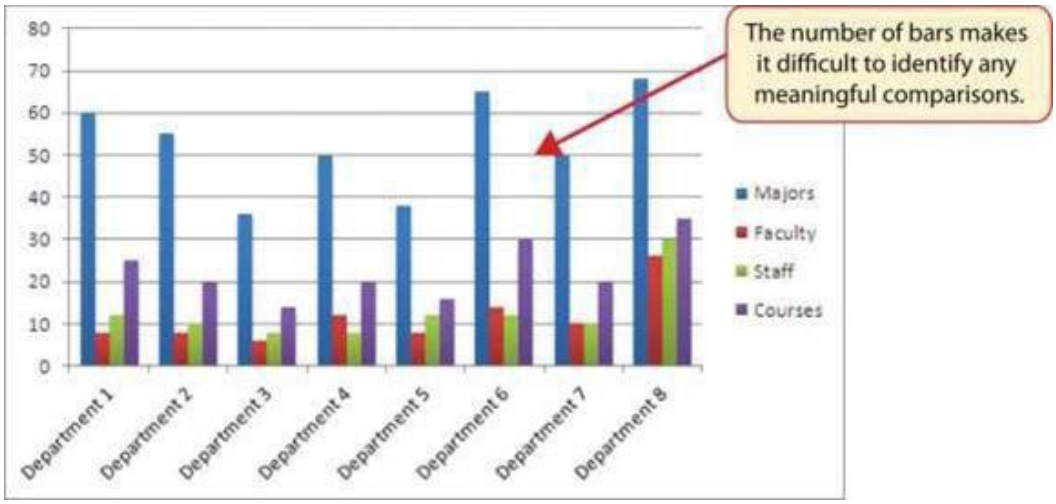
Figure 4.16b Selecting Non-contiguous Ranges



	A	B	C	D	E	F
1	Grade Distribution					
2		Number of Students			Percent Comparison	
3	Grade	Class	College		Class	College
4	A to A-	16	500		19.5%	25.0%
5	B+ to B-	26	600		31.7%	30.0%
6	C+ to C-	25	500		30.5%	25.0%
7	D+ to D-	10	300		12.2%	15.0%
8	F	5	100		6.1%	5.0%
9		82	2000			

Select your row and column labels
Hold the Ctrl key and drag through non-contiguous cells – don't forget your column labels

Figure 4.17Poor Use of a Column Chart



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Skill Refresher - Using Data in a Noncontiguous Range -Option 2
1. Click a blank cell location that is not adjacent to any data on the worksheet. 2. Click the Insert tab of the Ribbon. 3. Select a chart type and format in the Charts group of commands. 4. Click the Select Data button in the Design tab of the Chart Tools section of the Ribbon. 5. Click the Add button on the Select Data Source dialog box. 6. In the Edit Series dialog box, type a name in the Series name input box or highlight a cell location on the worksheet that contains a description for the data series. 7. Press the TAB key on your keyboard to advance to the Series values input box. 8. Highlight the range of cells on the worksheet that contains the data that will appear on the Y axis for the series identified in step 6. 9. Click the OK button on the Edit Series dialog box. 10. Repeat steps 5 through 9 for each data series that you need to add to the chart. 11. Click the Edit button on the right side of the Select Data Source dialog box. 12. Highlight the range of cells that contain the descriptions for the X axis. 13. Click the OK button on the Axis Labels dialog box. 14. Click the OK button on the Select Data Source dialog box

Combo Chart: Non-comparative values

Follow-along file: Continue with Excel Objective 4.00. (Use file Excel Objective 4.06 if starting here.)

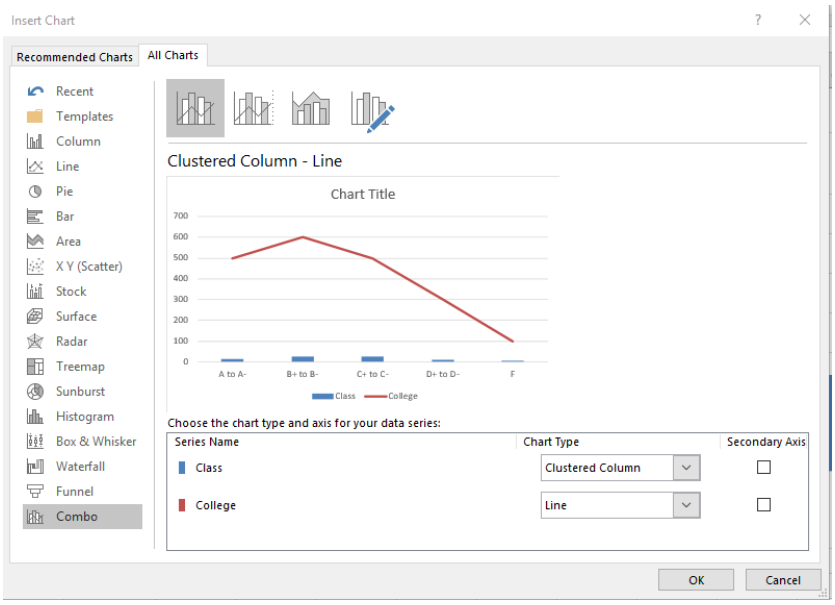
Remember, when building the second frequency chart above we created percentages to create a chart that had comparative value. However, we do have a chart type that can take disparate values like those of comparing a class to the college as a whole. This chart is the Combo chart. It uses both columns and lines to display data in such a way that it can be meaningful. The combo chart uses the vertical Axis to convey meaning to the data being presented. We will create a Combo chart to show a comparison between two frequency distributions. Column C on the **Grade Distribution** worksheet contains data showing the number of students who received grades within each category for the entire college. We will use a column chart to compare the grade distribution for the class (Column B) with the overall grade distribution for the college (Column C).

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

However, since the number of students in the class is significantly different from the total number of students in the college, we will make the class grades a column chart and the college grades a line chart. The steps to do this are:

1. On the Grade Distribution worksheet, highlight the range B3:C8
2. From the Insert ribbon click on Recommended Charts, then select the All Charts tab, and then Combo Chart.

Figure 4.18 Insert Combo Chart



3. You'll notice that our chart example looks a bit strange. We need to define which series will be the line and which will be the clustered column. We will take the default selected here, but the chart types can be changed by using the drop-down next to each chart type.
4. Next, we need to tell Excel which series we want to be our secondary vertical axis. The values for this axis will be shown on the left side of the chart and the values for the primary will show on the right. We will select the line chart to be our secondary axis.
5. You will see the chart example change so that now there is a meaningful chart showing. Click the OK button.
6. Next, we will put in our vertical axis titles, so the chart is easier to read. From the Chart Tools Design ribbon, Add Chart Element, select Axis Titles and Primary Vertical Axis.
7. With the Axis Title box active, type Class Students in the Formula bar and hit Enter.
8. Now we will add the secondary vertical axis following the same steps above, except selecting Secondary Vertical Axis.
9. With the Axis Title box active, type College Students in the Formula bar and hit Enter.
10. We will rotate the College Students axis label by going to the Home ribbon and in the Alignment, section rotate the text down.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.19 Rotating Text in Secondary Axis

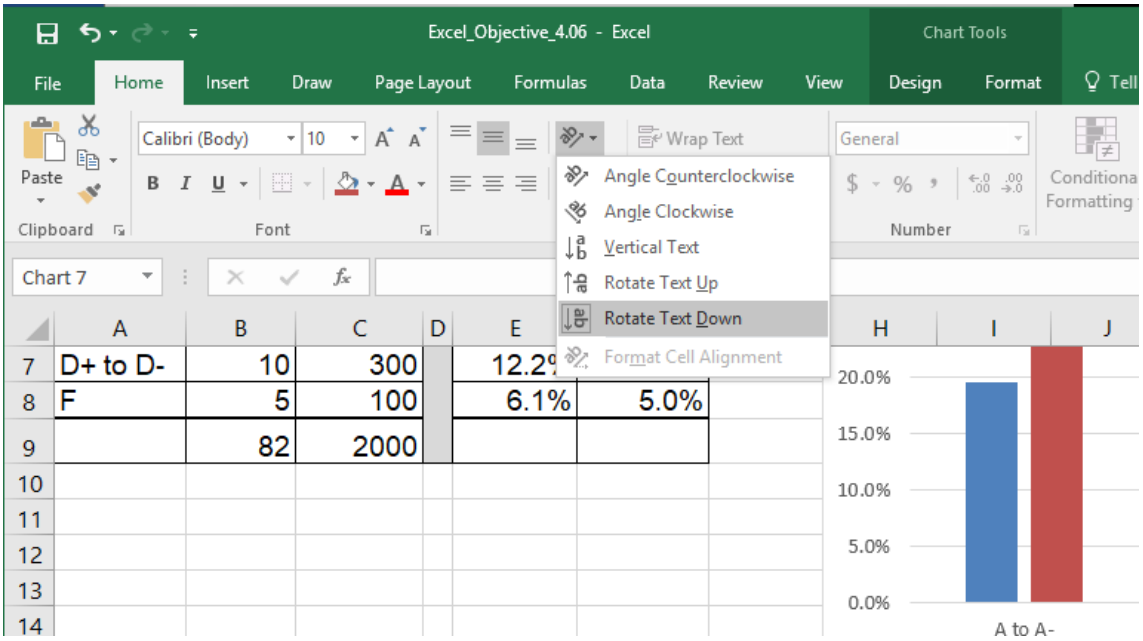
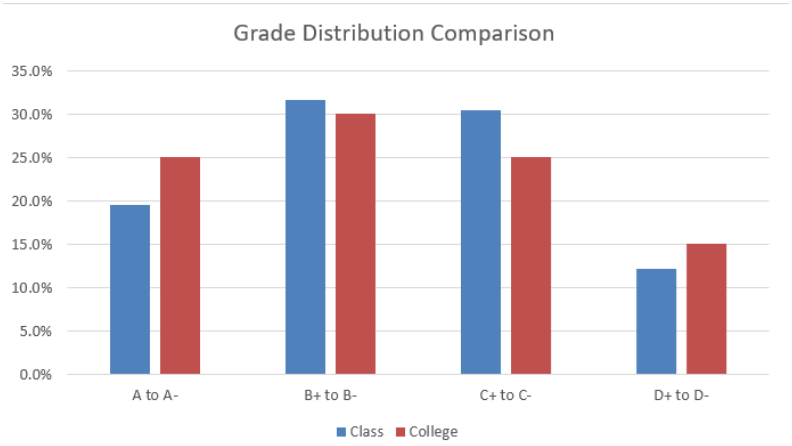
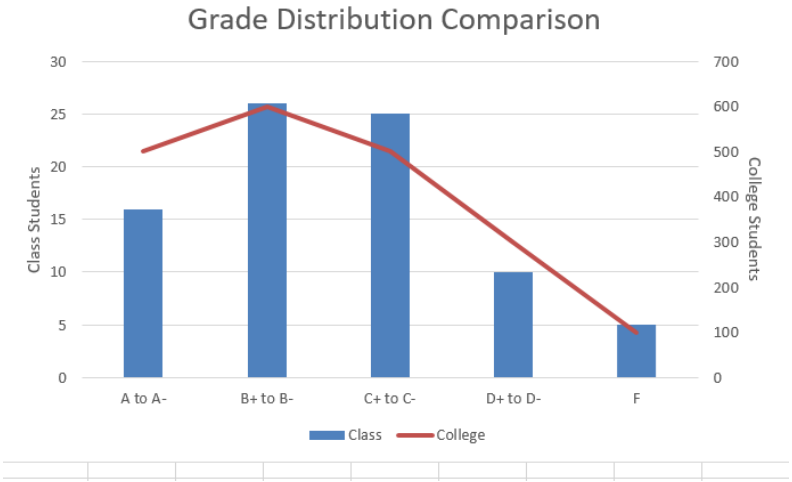


Figure 4.19 Completed Clustered Column and Combo Charts





Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Pie Chart: Percent of Total

Follow-along file: Continue with Excel Objective 4.00. (Use file Excel Objective 4.07 if starting here.)

The **Health Care** worksheet contains data that shows total spending in the United States for the years 1975 and 2015. In 1975, the total amount spent in the United States for health-related expenses was over $135 billion. The total amount spent in 2015 was over $3.2 trillion.

The next chart we will demonstrate is a pie chart. A pie chart is used to show a percentage of total for **a** data set at a specific point in time. In the case of our health care data, you can choose either the 1975 data, the 2015 data, or the total spent for the two time periods. You cannot use a pie chart to chart all three columns.

The data we will use to demonstrate a pie chart is related to the overall spending activity in the health-care industry for 1975. The pie chart shows how this $135 billion was funded. The following steps explain how to accomplish this:

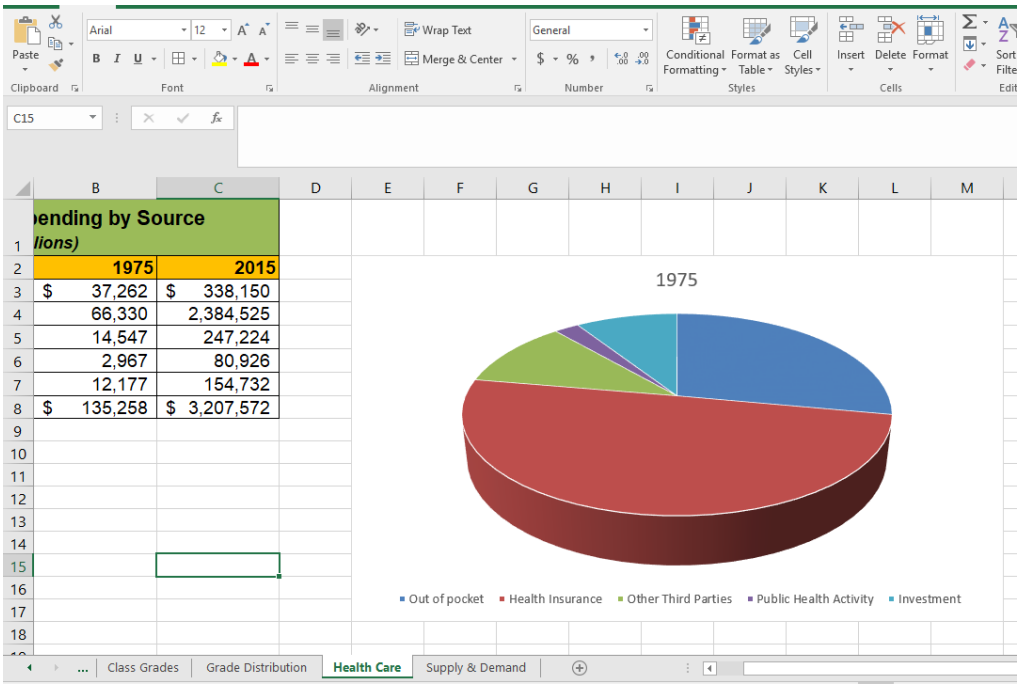
1. Highlight the range A2:B7 on the **Health Care** worksheet.

	A	B	C
1	**US Health Care Spending by Source** *(in millions)*		
2		**1975**	**2015**
3	Out of pocket	$ 37,262	$ 338,150
4	Health Insurance	66,330	2,384,525
5	Other Third Parties	14,547	247,224
6	Public Health Activity	2,967	80,926
7	Investment	12,177	154,732
8	Total	$ 135,258	$ 3,207,572

2. Click the Insert tab of the Ribbon.
3. Click the Pie button in the Charts group of commands.
4. Select the "3-D Pie chart" option in the middle section of the drop-down list of options.
5. Click and drag the pie chart so the upper left corner is in the middle of cell E2.
6. Resize the pie chart so the left side is locked to the left side of Column E, the right side is locked to the right side of Column M, the top is locked to the top of Row 2, and the bottom is locked to the bottom of Row 17 (see Figure 4.18 "Pie Chart Moved and Resized").

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

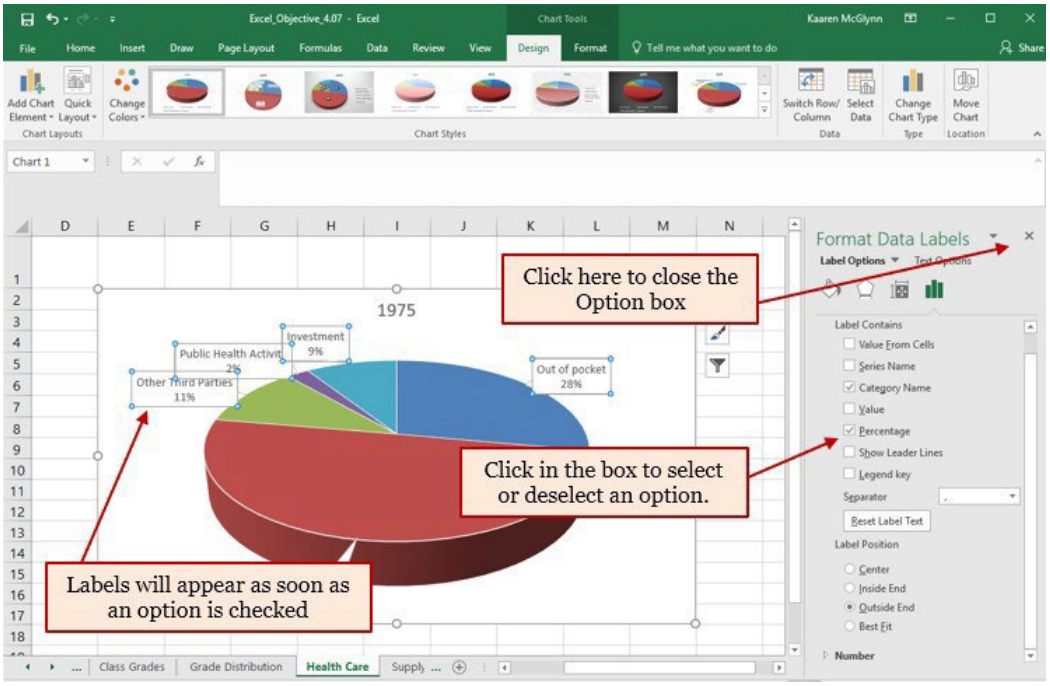
Figure 4.18 Pie Chart Moved and Resized



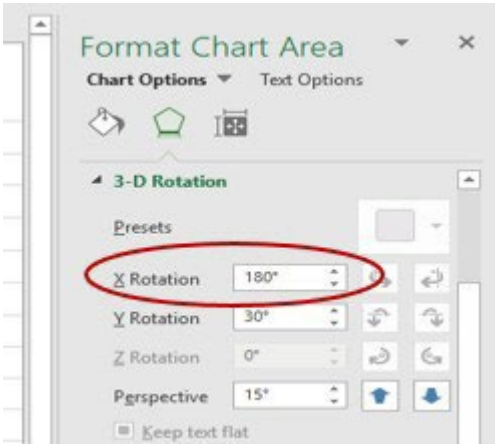
7. Click the chart legend once and press the DELETE key on your keyboard. A pie chart typically shows labels next to each wedge. Therefore, the legend is not needed.
8. Click the Add Chart Element button on the Design tab of the Chart Tools section of the Ribbon and select Data Labels from the drop-down list.
9. Select More Data Label Options from the drop-down list. This opens the Format Data Labels dialog box.
10. Click the box next to the Value option under the Label Options section in the Format Data Labels dialog box. This removes the check mark.
11. Click the Percentage option under the Label Options section in the Format Data Labels dialog box. A green check should appear in the box next to this option.
12. Click the Category Name option under the Label Options section in the Format Data Labels dialog box. A check should appear in the box next to this option.
13. Click the Close button at the top of the Format Data Labels dialog box.
14. Click the Home tab of the Ribbon and then click the Bold button. This should bold the data labels on the pie chart.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.19 Final Settings in the Format Data Labels Dialog Box



15. This is looking better, but some of our data labels are overlapping. We will correct that by rotating our 3-D chart. While the chart is still selected, right click and select 3-D rotation from the drop-down menu. *Note: Only 3-D charts can be rotated.*



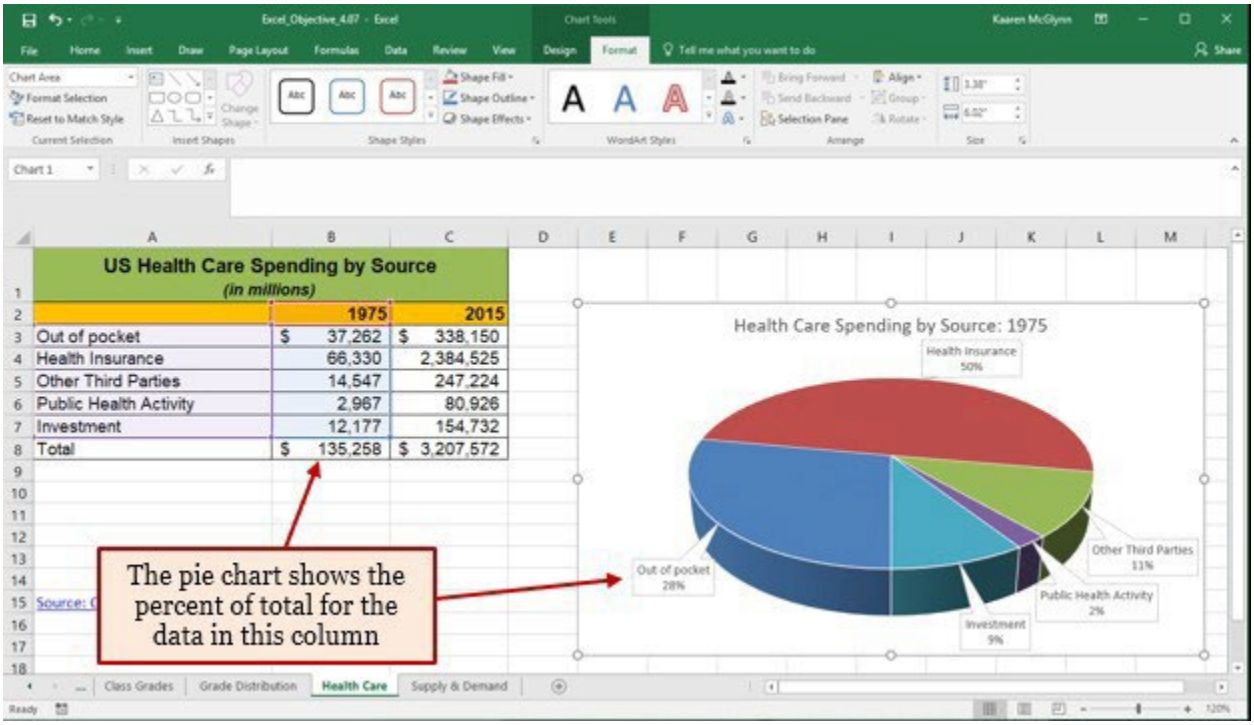
16. From the 3-D Rotation format area, rotate the X rotation by 180 degrees. Close the Format Chart Area options.
17. Make the chart title active by clicking on the 1975.
18. Click in front of the year 1975 and type Health Care Spending by Source.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.20 "Final Health Care Pie Chart" shows the completed pie chart. You can quickly see that Health Insurance and Out of Pocket made up the majority of health-care spending in 1975. Like the column chart, the key to creating an effective pie chart is the number of categories presented on the chart.

Although there are no specific limits for the number of categories you can use on a pie chart, a good rule of thumb is ten or less. As the number of categories exceeds ten, it becomes more difficult to identify key categories that make up the majority of the total. In this example, it is easy to see that two categories compose 75% of the total.

Figure 4.20 Final Health Care Pie Chart


US Health Care Spending by Source
(in millions)
1975
2015
Out of pocket $ 37,262 $ 338,150
Health Insurance 66,330 2,384,525
Other Third Parties 14,547 247,224
Public Health Activity 2,967 80,926
Investment 12,177 154,732
Total $ 135,258 $ 3,207,572
The pie chart shows the percent of total for the data in this column
Health Care Spending by Source: 1975
Health Insurance 50%
Other Third Parties 11%
Public Health Activity 2%
Investment 5%
Out of pocket 28%

Skill Refresher - Inserting a Pie Chart
1. Highlight a range of cells that contain one set of data you will use to create the chart.
2. Click the Insert tab of the Ribbon.
3. Click the Pie button in the Charts group.
4. Select a format option from the Pie Chart drop-down menu.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Stacked Column Chart: Percent of Total Trend:

Follow-along file: Continue with Excel Objective 4.00. (Use file Excel Objective 4.07 if starting here.)

The last chart type we will demonstrate is the stacked column chart. We use a stacked column chart to show how a percentage of total changes over time. For example, the data on the **Health Care** worksheet shows spending by source for 1975 and 2015. A stacked column chart can show whether there is any change in the percent of total for each source between the two years. Remember that with a pie chart we are limited to one data series only. In a stacked column chart, we can have multiple data series and use them for comparative purposes.

On the stacked column chart the Y axis of the chart shows the percentage from 0% to 100%. The X axis shows the two years: 1975 and 2015. The following steps explain how to create this chart:

1. Highlight the range A2:C7 on the **Health Care** worksheet. *Note: never include the total row or column unless that is the only data you are charting.*
2. Click the Insert tab of the Ribbon.
3. Click the Column button in the Charts group of commands. Select the 100% Stacked Column format option from the drop-down list (see Figure 4.21 "Selecting the 100% Stacked Column Format").

Figure 4.21 Selecting the 100% Stacked Column Format

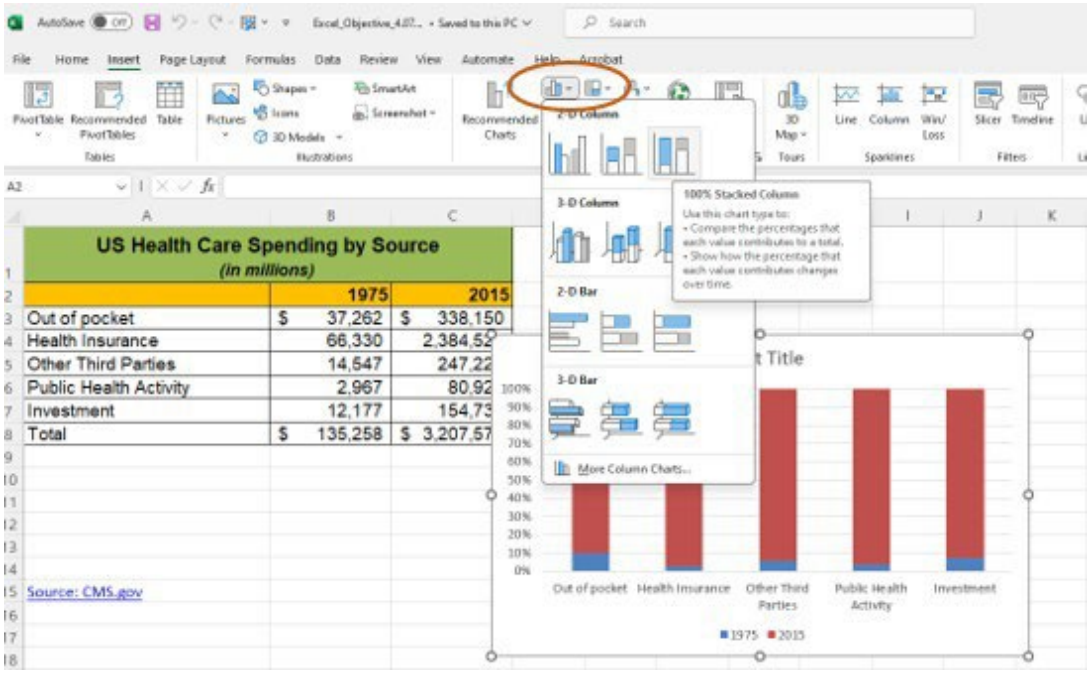
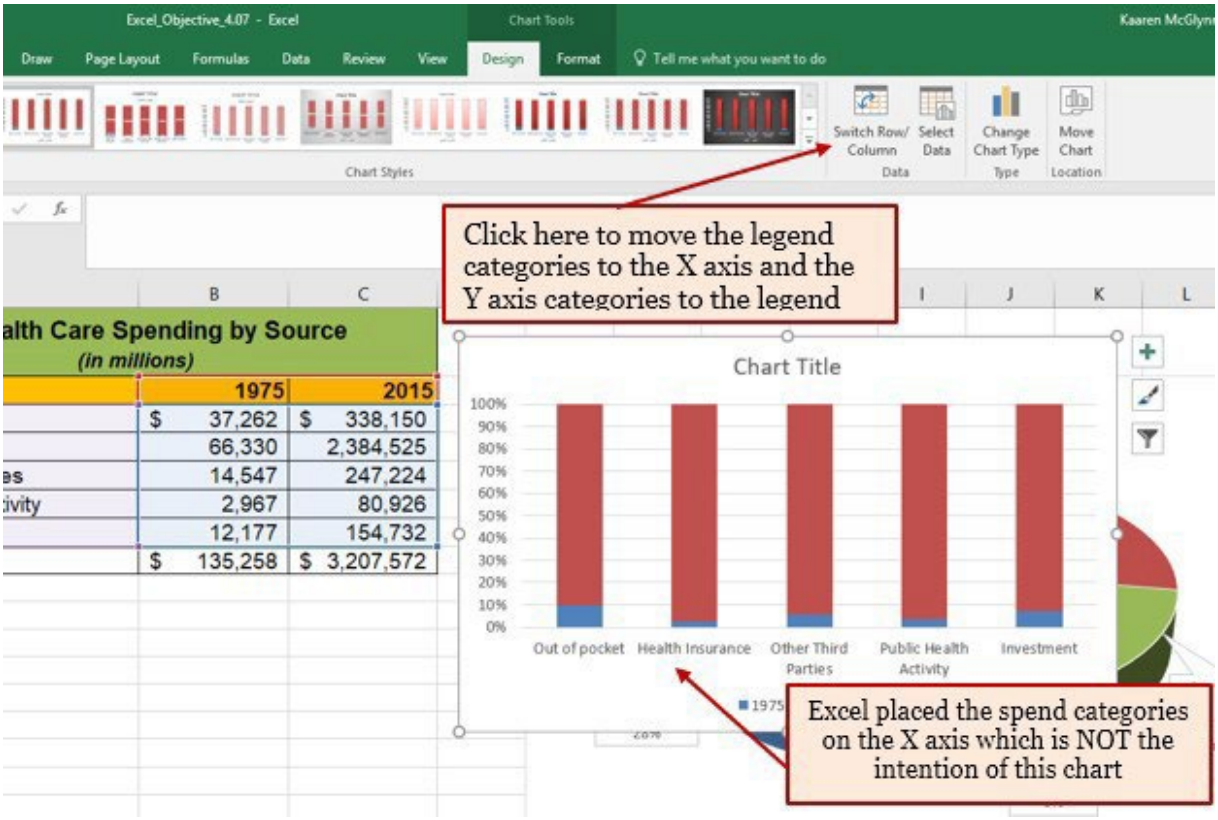


Figure 4.22 "Initial Construction of the 100% Stacked Column Chart" shows the column chart that is created after selecting the 100% Stacked Column format option. As mentioned,

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

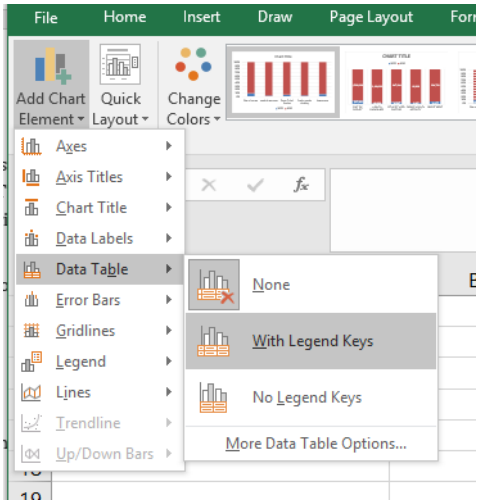
the goal of this chart is to show the percentages on the Y axis and the years 1975 and 2015 on the X axis. However, notice that Excel places the spend sources on the X axis. The remaining steps explain how to correct this problem and complete the chart:

Figure 4.22 Initial Construction of the 100% Stacked Column Chart



4. Click the Switch Row/Column button in the Design tab on the Chart Tools section of the Ribbon. This reverses the legend and current X axis categories.
5. Click and drag the chart so the upper left corner is in the middle of cell E19.
6. Resize the chart so the left side is locked to the left side of Column E, the right side is locked to the right side of Column N, the top is locked to the top of Row 19, and the bottom is locked to the bottom of Row 37.
7. Click the legend one time and press the DELETE key on your keyboard.
8. Click the Layout tab on the Chart Tools section of the Ribbon.
9. Click the Add Chart Element and select Data Table with Legend Keys option from the drop-down menu. This is another way of displaying a legend for a column chart along with the numerical values that make up each component. *Note: It is generally better to not include the data table in your charts as it clutters more than helps. In this example, it is appropriate.*

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International



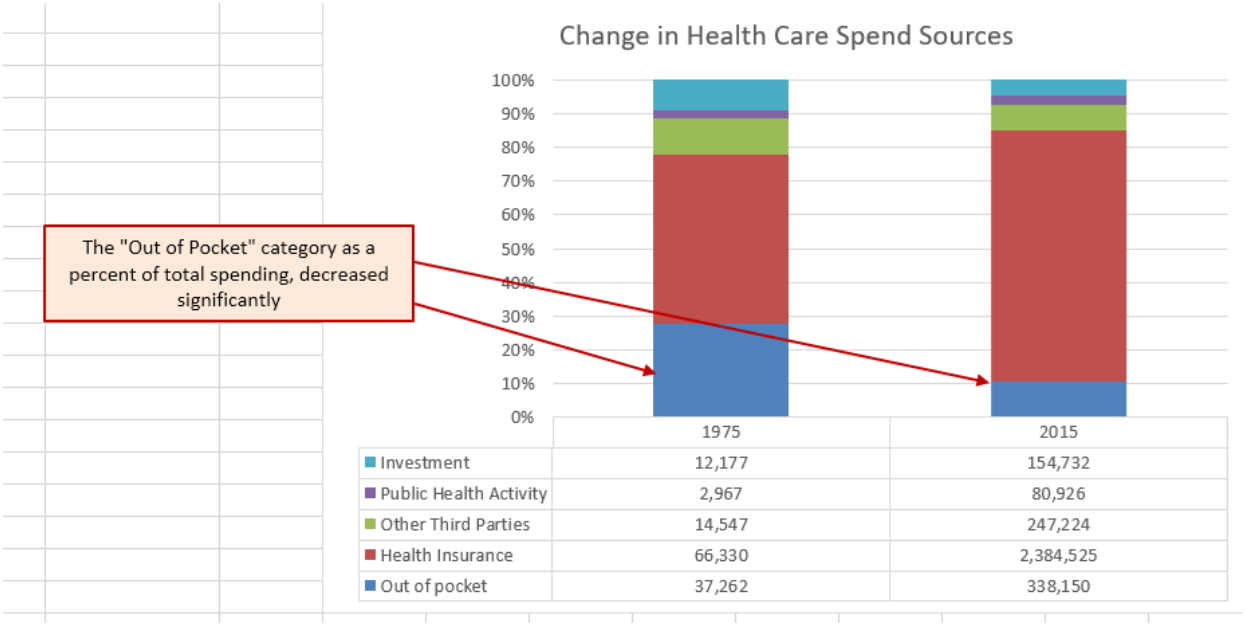
10. Click the chart title button in the Layout tab of the Chart Tools section of the Ribbon.
11. Select the Above Chart option for the drop-down menu.
12. Click the chart title two times. Delete the generic chart title name and type **Change in Health Care Spend Source**.

Figure 4.23 "Final 100% Stacked Column Chart" shows the final stacked column chart. Notice that the Out-of-Pocket category, or the amount of cash people paid for health-care expenses, decreased significantly from 1975 to 2015. However, the Health Insurance category increased significantly from 1975 to 2015.

Overall, the chart shows that the total out-of-pocket and health insurance expense increased significantly from 1975 to 2015. These two categories made up approximately 77% of total health-care spending in 1975. By 2015, these two categories increased to over 85% of total health-care spending.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.23 Final 100% Stacked Column Chart



Skill Refresher - Inserting a Stacked Column Chart
Highlight a range of cells that contain data that will be used to create the chart. Click the Insert tab of the Ribbon. Click the Column button in the Charts group. Select the Stacked Column format option from the Column Chart drop-down menu to show the values of each category on the Y axis. Select the 100% Stacked Column option to show the percent of total for each category on the Y axis.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

EXERCISES

1. You need to create a chart showing the past year sales results for the university bookstore. Your chart will show the total sales by month for twelve months. Which of the following is the best chart type?

   a. pie chart
   b. line chart
   c. scatter chart
   d. either line or column chart

2. Which of the following should you do first to create an effective chart in Excel?

   a. Identify a chart type.
   b. Define the message you need to communicate.
   c. Determine which values belong on the Y axis.
   d. Highlight all the data on your worksheet.

3. Which of the following is the most efficient method for adding labels to each section of a pie chart?

   a. Select a Layout from the Quick Layout button in the Chart Layout tab of the Ribbon.
   b. Click the Text Box button in the Layout tab of the Ribbon and add labels next to each section of the chart.
   c. Use the Legend button in the Layout tab of the Ribbon to reposition the legend around each section of the chart.
   d. Click the Select Data button in the Design tab of the Ribbon to select and arrange specific data points to be placed on the chart.

4. You have established a personal budget for your household. The spending section of the budget is broken down into five major categories. To show how the percent of total for each spend category has changed over a three-year period, it would be best to use which of the following chart types?

   a. column chart
   b. line chart
   c. stacked column chart
   d. pie chart

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

4.2 Formatting Charts

LEARNING OBJECTIVES
1. Apply formatting commands to the X and Y axis. 2. Enhance the visual appearance of the chart title and chart legend by using various formatting techniques. 3. Assign titles to the X and Y axes that clarify labels and numeric values for the reader. 4. Apply labels and formatting techniques to the data series in the plot area of a chart. 5. Apply formatting commands to the chart area and the plot area of a chart. 6. Employ series lines and annotations to enhance trends and provide additional information on a chart.

There are a variety of formatting techniques to enhance the appearance of a chart once you have created it. Formatting commands are applied to a chart for the same reason they are applied to a worksheet: to make the chart easier to read. However, formatting techniques can help you qualify and explain the data in a chart. For example, you can add footnotes explaining the data source as well as notes that clarify the type of numbers being presented (i.e., if the numbers in a chart are truncated, you can state whether they are in thousands, millions, etc.). These notes are also helpful in answering questions if you are using charts in a live presentation. These formatting techniques will be demonstrated using the column chart and stacked column chart from the previous section.

Getting to Know the Elements of a Chart

A chart has many elements. Some of these elements are displayed by default, others can be added as needed. You can change the display of the chart elements by moving them to other locations in the chart, resizing them, or by changing the format. You can also remove chart elements that you do not want to display.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

© Microsoft Corporation

1. The chart area of the chart.
2. The plot area of the chart.
3. The data points of the data series are plotted in the chart.
4. The horizontal (category) and vertical (value) axis along which the data is plotted in the chart.
5. The legend of the chart.
6. A chart and axis title that you can use in the chart.
7. A data label that you can use to identify the details of a data point in a data series.

X and Y Axis Formats

Follow-along file: Continue with Excel Objective 4.00. (Use file Excel Objective 4.08 if starting here.)

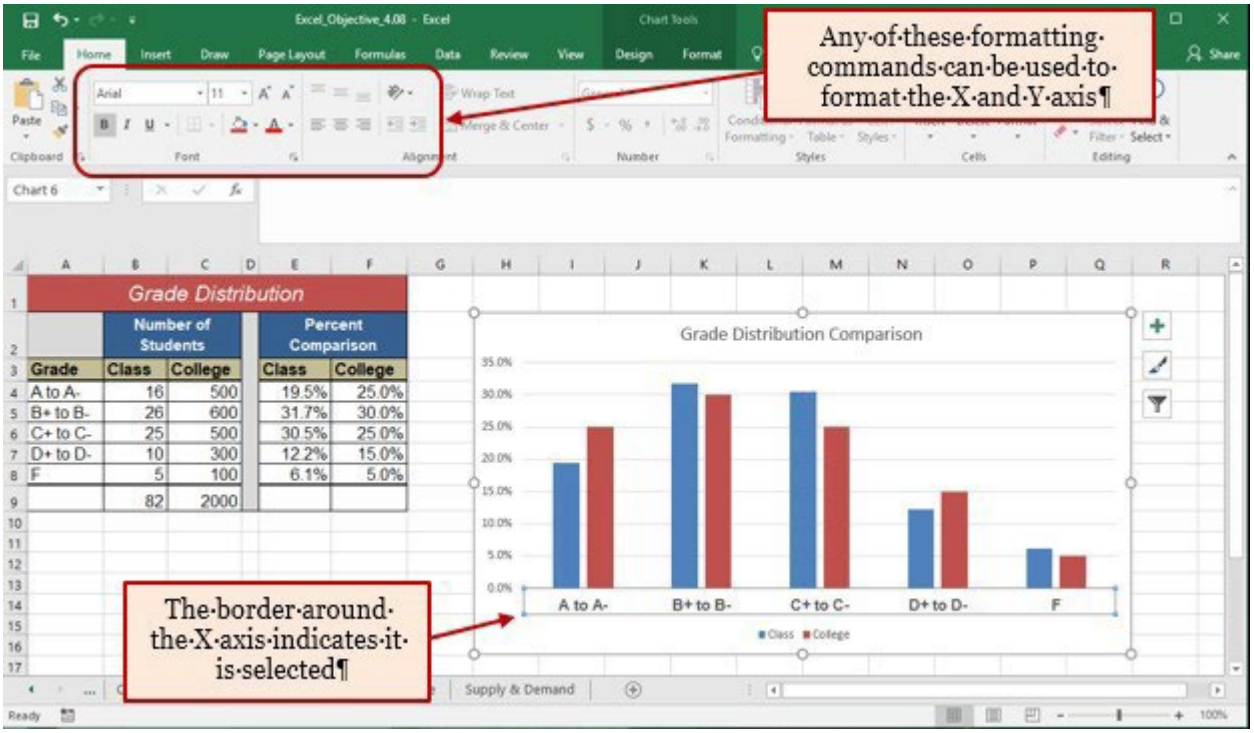
There are numerous formatting commands that can be applied to the X and Y axes of the chart. Although adjusting the font size, style, and color are common, many more options are available through the Format Axis dialog box (see Figure 4.5 "Format Axis Dialog Box"). The following steps demonstrate a few of these formatting techniques on the Grade Distribution Comparison chart:

1. Click anywhere along the X axis (horizontal axis) of the Grade Distribution Comparison chart on the **Grade Distribution** worksheet.
2. Click the Home tab of the Ribbon.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

3. Change the font style to Arial. Notice that as the mouse pointer hovers over a font style, you can preview the change on the chart before you make a selection.
4. Change the font size to 11 points and bold the font. The final appearance of the X axis is shown in Figure 4.24 "Formatted X Axis".
5. Click anywhere along the Y axis to activate it.
6. Repeat steps 3 and 4.

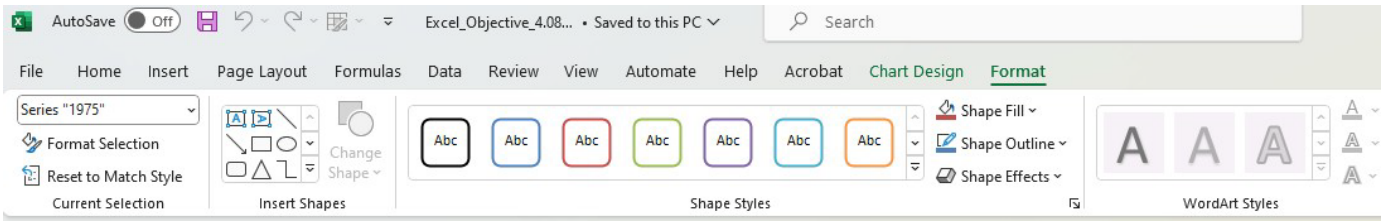
Figure 4.24 Formatted X Axis

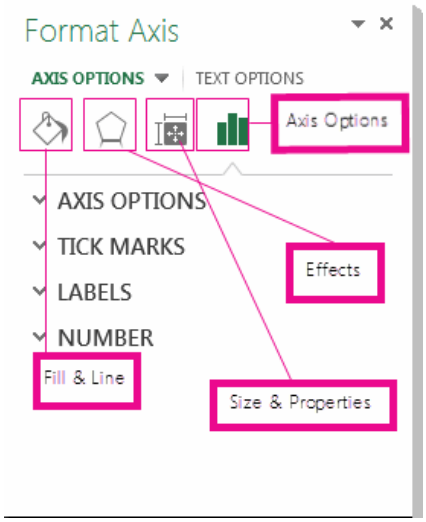


7. Click the Format tab in the Chart Tools section of the Ribbon.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

8. Click the Format Selection button in the Current Selection group of commands. This opens the Format Axis dialog box. *Note: you can access any of the formatting dialog boxes by right clicking on the area you wish to format. Then select format (whichever area you choose).*





9. Click Number from the bottom of the Axis (see Figure 4.25 "Formatting Numbers on the Y Axis"). The commands in this section of the Format Axis dialog box are used to format numbers that appear on the X and Y axes of a chart.

10. Click in the Decimal places input box and change the value to 0.

11. Click the X button at the top right of the Format Axis dialog box. The formatting adjustments are shown in Figure 4.26 "Completed X and Y Axis Formats".

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.25 Formatting Numbers on the Y Axis

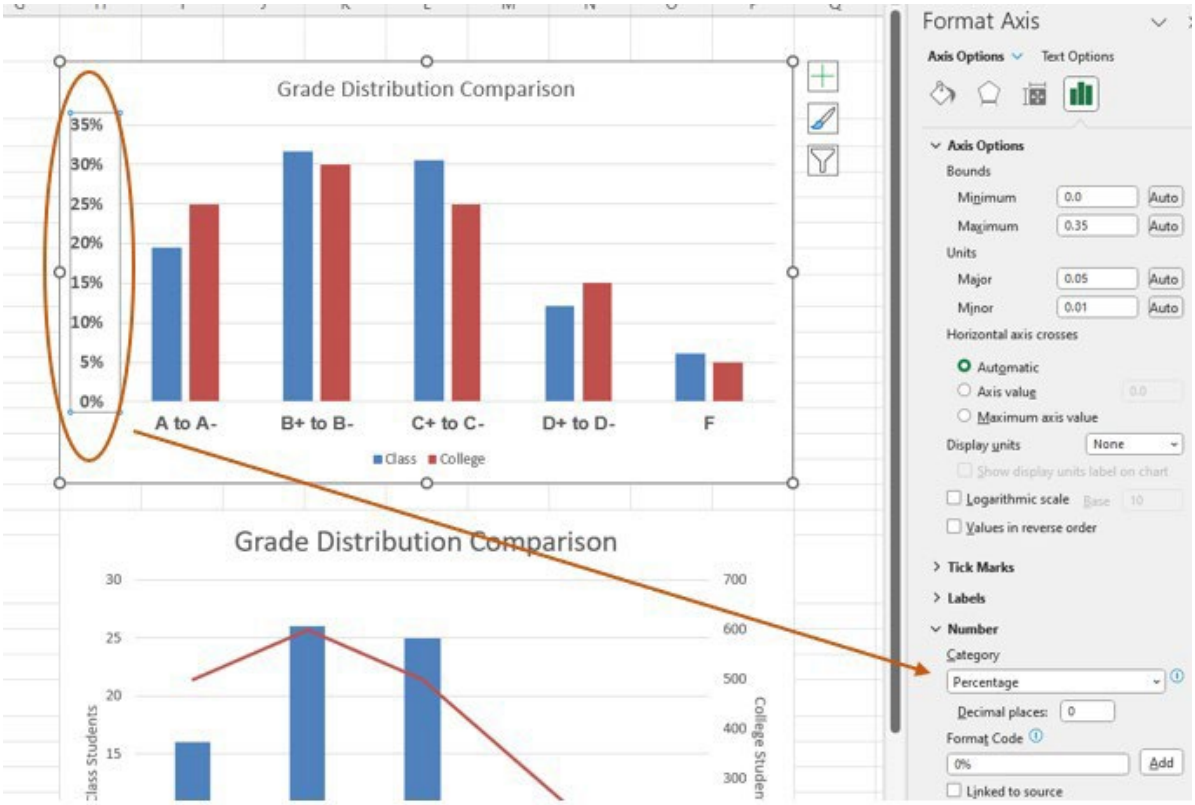
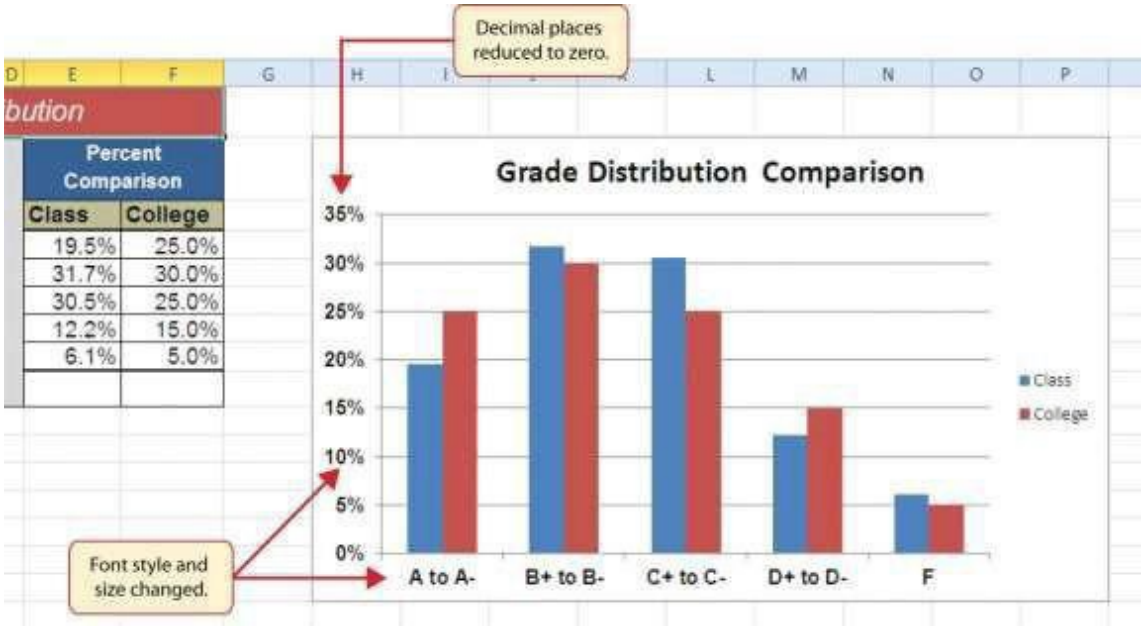


Figure 4.26 Completed X and Y Axis Formats



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Skill Refresher - Formatting the X and Y Axes

1. Click anywhere along the X or Y axis to activate it.
2. Click either the Home tab or Format tab of the Ribbon.
3. Select any of the available formatting commands on these tabs.

Skill Refresher - X and Y Axis Number Formats

1. Click anywhere along the X or Y axis to activate it.
2. Click the Layout tab in the Chart Tools section of the Ribbon. (*You can right click on the X or Y axis and select Format Axis from the drop-down list. Double clicking the axis will also open the Format dialog box)*
3. Click the Format Selection button in the Current Selection group of commands.
4. Click Number from the list of options in the Format Axis dialog box.
5. Select the Number format and set decimal places to the desired number.
6. Click the X button at the top right of the Format Axis dialog box to close the Format Axis.

Chart Legend and Title Formats

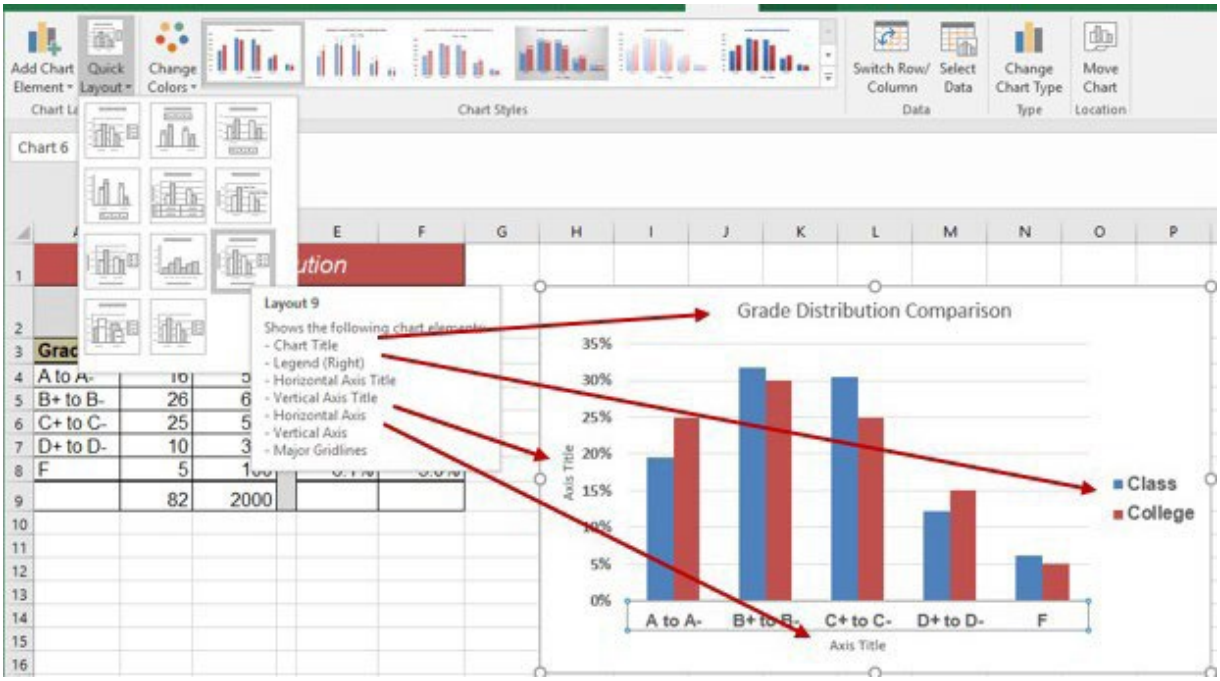
Follow-along file: Continue with Excel Objective 4.00. (Use file Excel Objective 4.09 if starting here.)

The next items we will format on the Grade Distribution Comparison chart are the chart legend, axis titles and chart title. Like how we formatted the X and Y axes, we can format these items by activating them and using the formatting commands in the Home tab or the Format tab of the Ribbon. We will use the Quick Layout button on the Chart Tools Design ribbon to add axis titles and move the legend. The following steps explain how to add these formats:

1. Activate the Grade Distribution chart on the Grade Distribution worksheet. From the Chart Tools Design ribbon click on the Quick Layout button. AS you scroll through the different layouts you will see your chart change. Select Layout 9. This will add your axis titles, keep the chart title, and move the legend to the right side of the Plot area. (*Note: if you accidentally select a quick layout that eliminates the title, you will have to redo your title text.)*

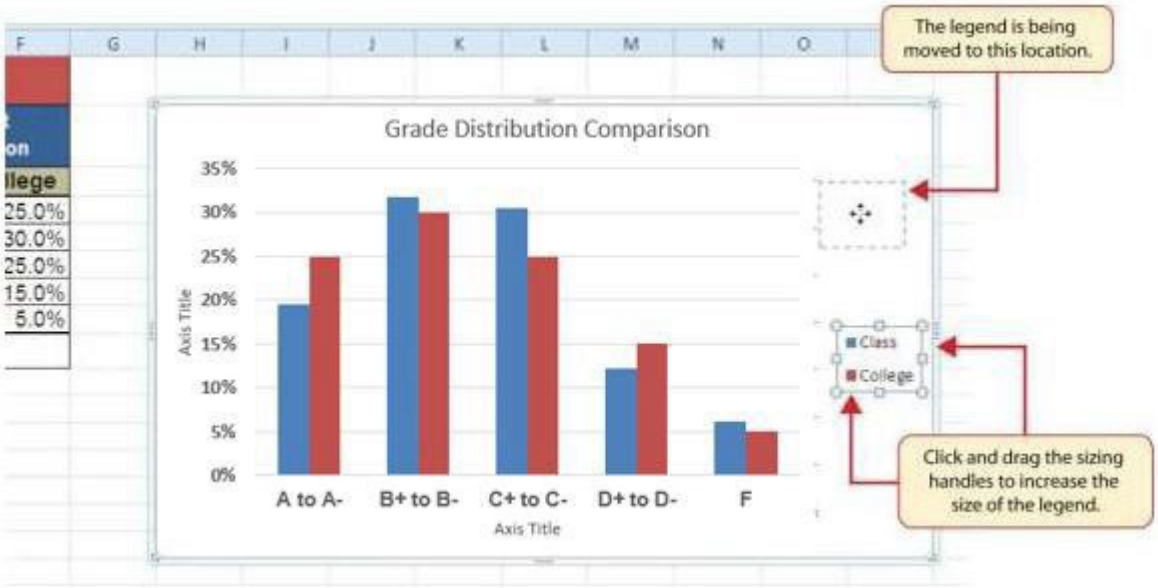
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.27 Quick Layout



2. Click and drag the legend so the top of the legend aligns with the 35% line next to the plot area (see Figure 4.27-2 "Moving the Legend").

Figure 4.28 Moving the Legend

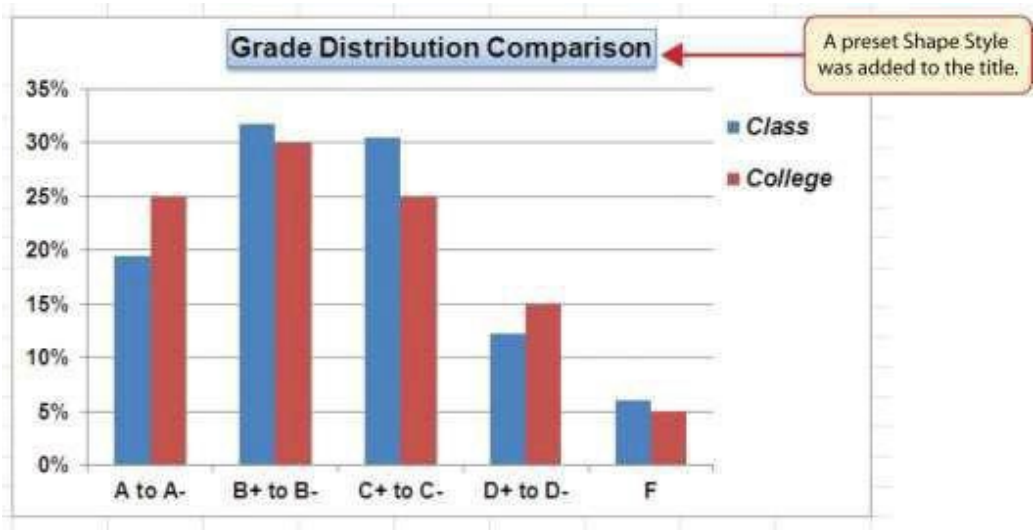


3. Click and drag the lower center sizing handle so the bottom of the legend is aligned with the 25% line of the plot area.
4. Click and drag the left sizing handle so the legend is against the plot area.
5. Change the font style in the Home tab of the Ribbon to Arial.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

6. Change the font size to 12 points.
7. Click the bold and italics commands in the Home tab of the Ribbon.
8. Click the chart title to activate it.
9. Click the Format tab in the Chart Tools section of the Ribbon.
10. Click the More down arrow in the Shape Styles group of commands to open the complete set of preset format styles.
11. Click the Blue Subtle Effect, Accent 1 option, which is in the first row, second style from the left. As the mouse hovers over a style, you can preview the appearance on the chart.
12. In the Home tab of the Ribbon, change the font style to Arial and reduce the font size to 14 points (see Figure 4.29 "Chart Legend and Title Formatted").

Figure 4.30 Chart Legend and Title Formatted



Skill Refresher - Formatting the Chart Legend

1. Click the Legend to activate it.
2. Click either the Home tab or the Format tab of the Ribbon.
3. Select any of the available formatting commands in these tabs.
4. Click and drag the legend to move it.
5. Click and drag any of the sizing handles to adjust the size of the legend

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Skill Refresher - Formatting the Chart Title
1. Click anywhere on the chart title. 2. Click either the Home tab or the Format tab of the Ribbon. 3. Select any of the available formatting commands in these tabs.

X and Y Axis Titles

Follow-along file: Continue with Excel Objective 4.00. (Use file Excel Objective 4.10 if starting here.)

Titles for the X and Y axes are necessary for defining the numbers and categories presented on a chart. For example, by looking at the Grade Distribution Comparison chart, it is not clear what the percentages along the Y axis represent. In the last section, we added axis titles by using the Quick Layout button.

To add titles without using a Quick Layout, the following steps explain how to add titles to the X and Y axes to define these numbers and categories:

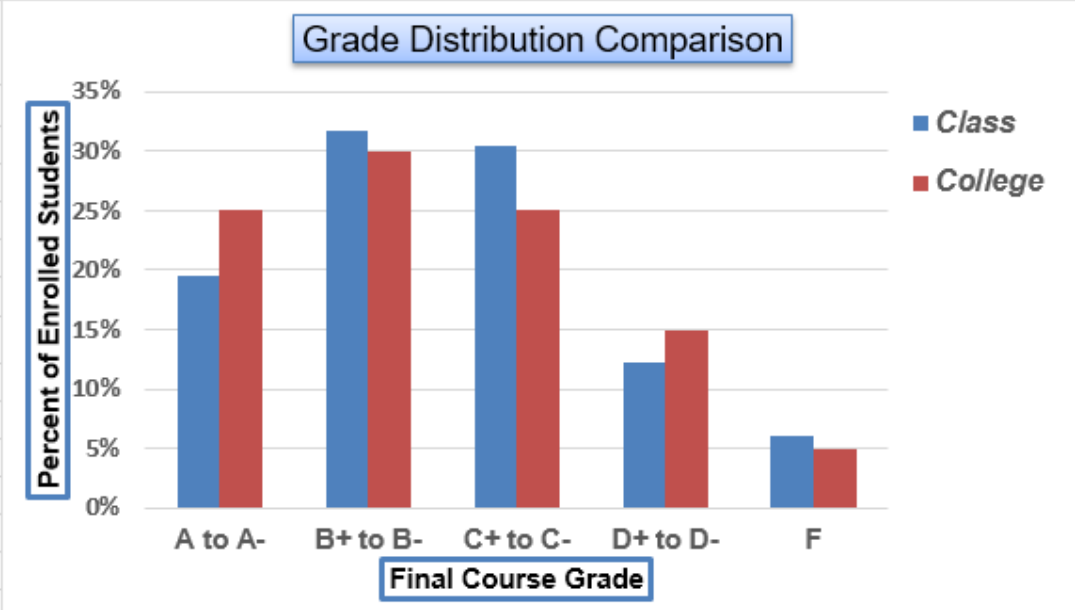
1. If you have axis titles already on your chart proceed to step 5.
2. Click anywhere on the Grade Distribution Comparison chart in the **Grade Distribution** worksheet to activate it.
3. Click the Add Chart Element button (or the quick select Add Element to the right of the activated chart).
4. Click the Axis Titles button in the Labels group of commands and select Primary Vertical Axis. This adds a title next to the Y axis. Repeat the above to add the Primary Horizontal Axis.
5. Click the Format tab in the Chart Tools section of the Ribbon.
6. Click the Colored Outline - Blue, Accent 1 preset style option in the Shape Styles group of commands.
7. Change the font style in the Home tab to Arial. Change the font size to 11 points and apply the bold format.
8. While the vertical Axis Title box is selected type **Percent of Enrolled Students** in the formula bar. Hit Enter when finished.
9. Click on the horizontal Axis Title.
10. Click the Format tab in the Chart Tools section of the Ribbon.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

11. Click the Colored Outline - Blue, Accent 1 preset style option in the Shape Styles group of commands.
12. Change the font style in the Home tab to Arial. Change the font size to 11 points and apply the bold format.
13. While the vertical Axis Title box is selected type **Final Course Grade** in the formula bar. Hit Enter when finished.

Figure 4.31 "X and Y Axis Titles Added" shows the added titles for the X and Y axes. The titles provide definitions for the grade categories along the X axis as well as the percentages on the Y axis.

Figure 4.31 X and Y Axis Titles Added



Skill Refresher - X and Y Axis Titles

1. Click anywhere on the chart to activate it.
2. Click the Design tab in the Chart Tools section of the Ribbon.
3. Click the Quick Layout button in the Chart Layouts group of commands.
4. Place the mouse pointer over the Primary Horizontal Axis Title (X axis) or the Primary Vertical Axis Title (Y axis) option.
5. Select one of the configuration formats from the second drop-down list that will insert axis titles.
6. Click on the axis title and in the formula bar type the title.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

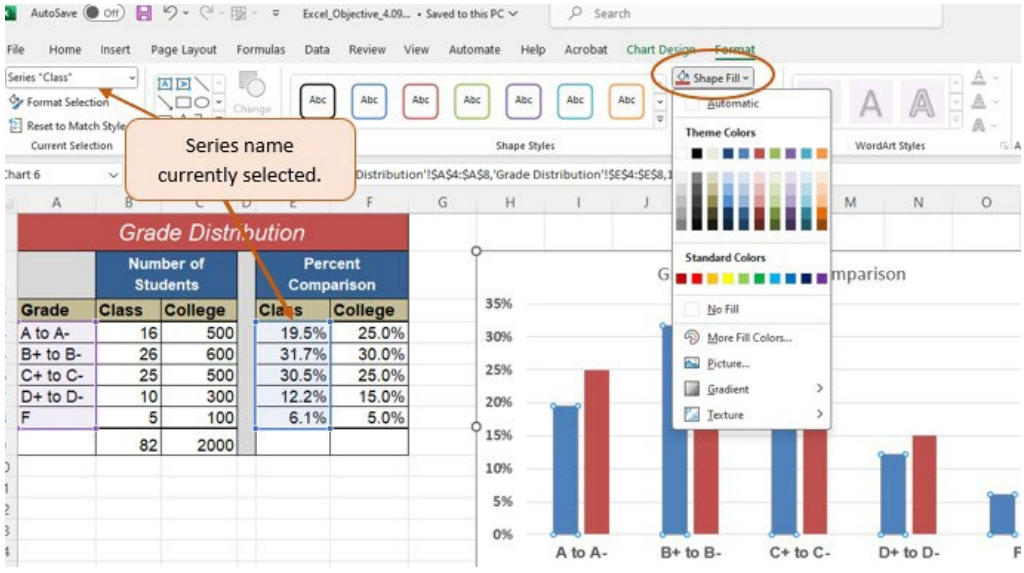
Data Series Labels and Formats

Follow-along file: Continue with Excel Objective 4.00. (Use file Excel Objective 4.11 if starting here.)

Adding labels to the data series of a chart is a formatting feature that may aid in bringing clarity to a chart. However, caution should be used so the chart does not become cluttered and hard to read. A data series is the item that is being displayed graphically on a chart. For example, the blue bars on the Grade Distribution Comparison chart represent one data series. We can add labels at the end of each bar to show the exact percentage the bar represents. In addition, we can add other formatting enhancements to the data series, such as changing the color of the bars or adding an effect. The following steps explain how to add these labels and formats to the chart:

1. Click any red bar representing the College data series on the Grade Distribution Comparison chart in the **Grade Distribution** worksheet. Clicking one bar automatically activates all bars in the data series. If you click a bar a second time, only that bar is activated.
2. Click the Format tab in the Chart Tools section of the Ribbon.
3. Click the down arrow on the Shape Fill button in the Shape Styles group of commands.
4. Click the orange color square from the drop-down color palette (see Figure 4.32" Changing the Color of a Data Series"). As you move the mouse pointer over colors on the palette, you can preview the change on the data bars.

Figure 4.32 Changing the Color of a Data Series



5. Click the Design tab in the Chart Tools section of the Ribbon.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

6. Click the Add Chart Element. button in the Labels group of commands. Select Data Labels, and then Outside End from the options in the drop-down list.
7. Right click on any of the labels and select Format Data Labels from the drop-down list.
8. Select Number in the Text Options Format window. Then, select Percentage in the Category box. Then change the decimal places to 0. (See Figure 4.33 "Adding Labels to a Data Series").
9. Click in the Decimal Places input box and change the number of decimal places to zero.
10. Click the Close button at the bottom of the Format Data Labels dialog box.
11. Click the Home tab of the Ribbon.
12. Change the font style to Arial, change the font size to 9 points, and select the Bold command.
13. Click any blue bar in the Class data series.
14. Repeat steps 5 through 12.

Figure 4.33 Adding Labels to a Data Series

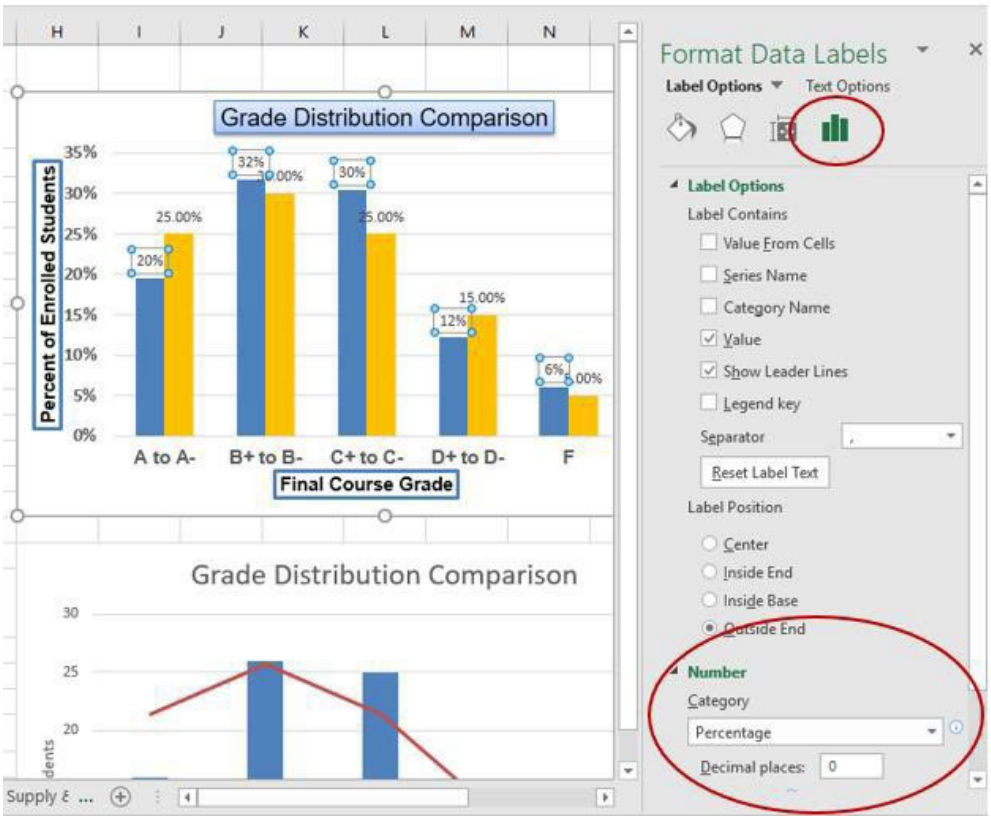
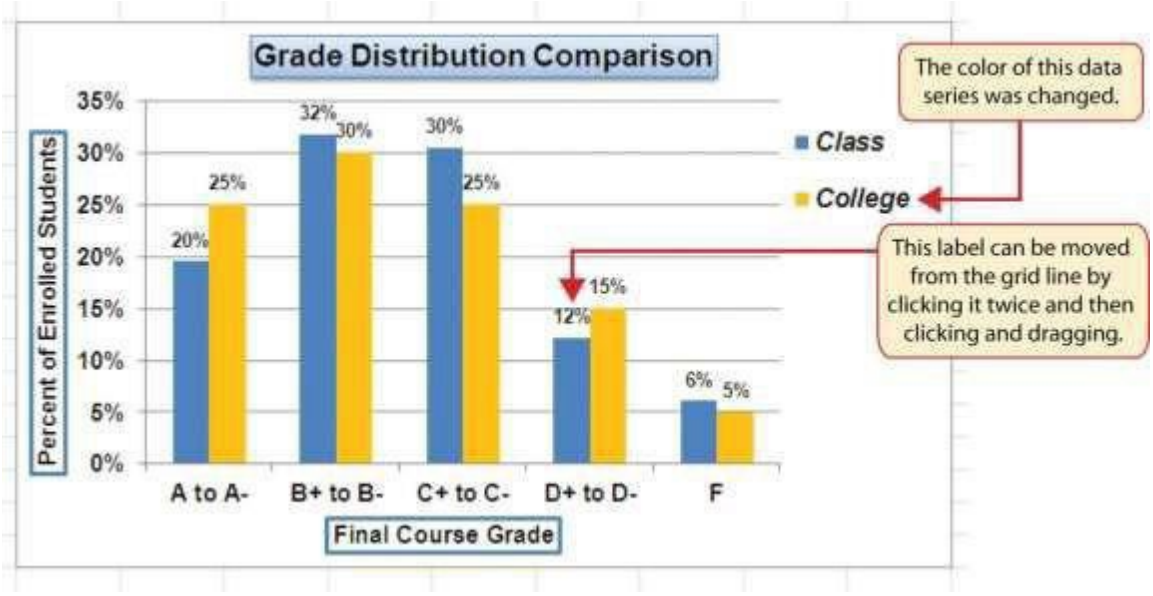


Figure 4.34 "Completed Formatting Adjustments for the Data Series" shows the Grade Distribution Comparison chart with the completed formatting adjustments and labels added to the data series. Note that we can move each individual data label. This might be

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

necessary if two data labels overlap or if a data label falls in the middle of a grid line. To move an individual data label, click it twice, then click and drag.

Figure 4.34 Completed Formatting Adjustments for the Data Series



Skill Refresher - Adding Data Labels
1. Click anywhere on the chart to activate it. 2. Click the Design tab in the Chart Tools section of the Ribbon. 3. Click the Add Chart Element. Select Data Labels from the drop-down list of commands. 4. Select one of the preset positions from the drop-down list or select More Data Label Options to open the Format Data Labels dialog box. 5. Select any of the available formatting commands in these tabs.

Formatting the Plot and Chart Areas

Follow-along file: Continue with Excel Objective 4.00. (Use file Excel Objective 4.12 if starting here.)

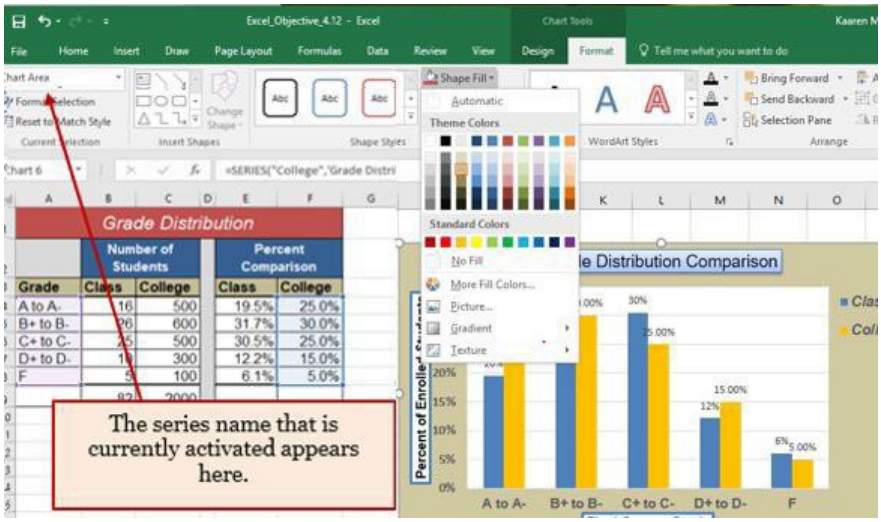
The next items to format on the Grade Distribution Comparison chart are the plot and chart areas. We can format these areas primarily to enhance the visibility of the data series. The following steps explain how to add these formatting enhancements to the chart:

1. Click anywhere in the chart area of the Grade Distribution Comparison chart in the **Grade Distribution** worksheet.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

2. Click the Format tab in the Chart Tools section of the Ribbon. Verify that the Chart Area is selected in the Current Selection section of the Format ribbon.
3. Click the down arrow on the Shape Fill button in the Shape Styles group of commands.
4. Select the Tan, Background 2, Darker 25% option from the color palette (see Figure 4.36 "Formatting the Chart Area").
5. Click anywhere in the plot area to activate it. Be sure not to click a grid line or one of the data series.
6. Click the Format tab in the Chart Tools section of the Ribbon.
7. Click the Shape Effects button in the Shape Styles group of commands.
8. Place the mouse pointer over the Bevel option from the drop-down list. Then select the Round bevel option from the second drop-down list (see Figure 4.37 "Putting a Bevel Effect on the Plot Area").

Figure 4.36 Formatting the Chart Area



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.37 Putting a Bevel Effect on the Plot Area

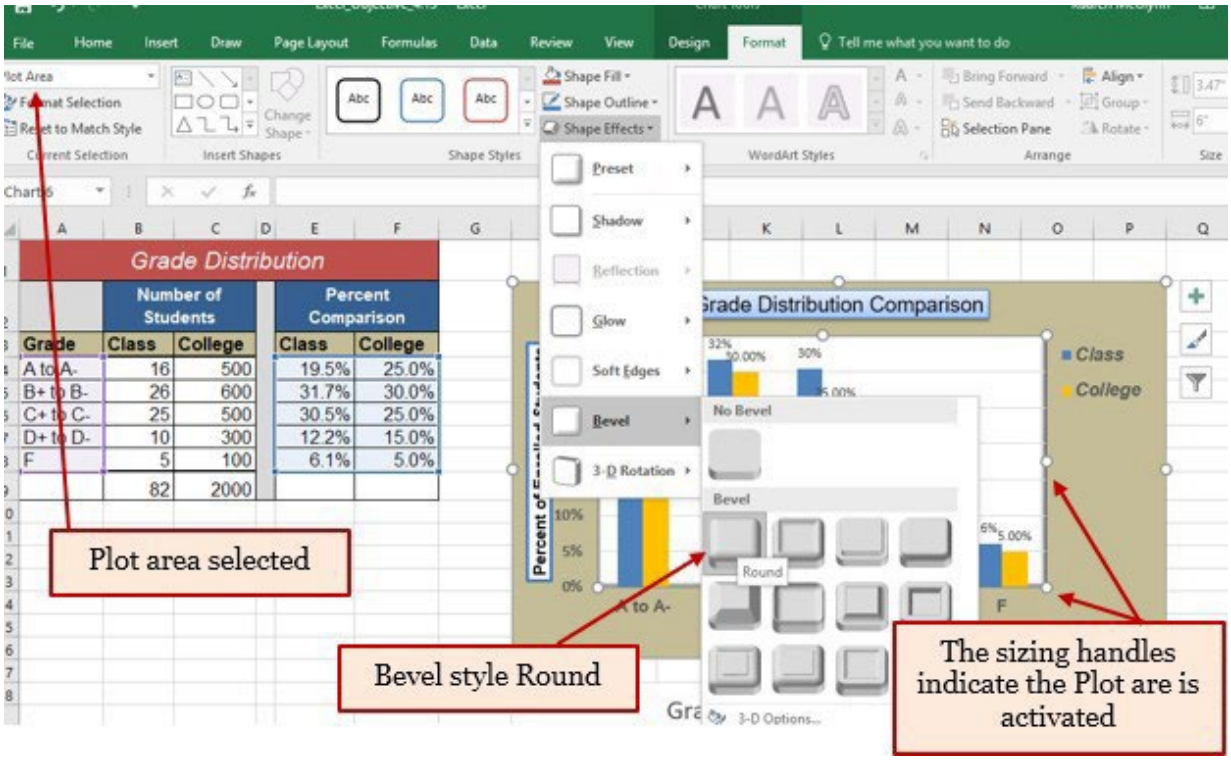
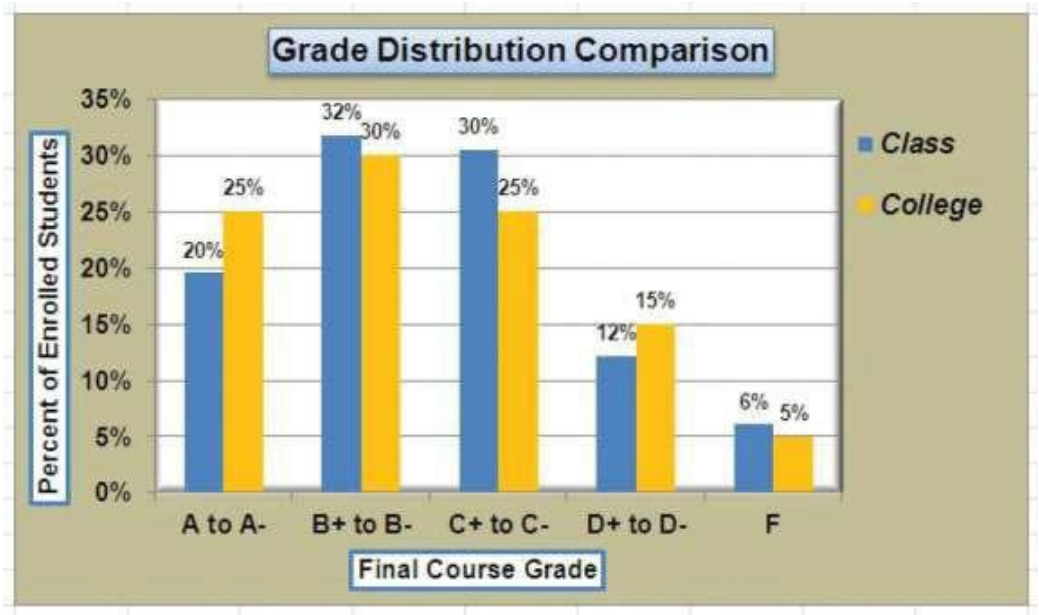


Figure 4.38 "Grade Distribution Comparison Chart with Formats Applied" shows the completed Grade Distribution Comparison chart. The darker shade on the chart area along with the bevel effect on the plot area make the data series the main focal point of the chart.

Figure 4.38 Grade Distribution Comparison Chart with Formats Applied



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Skill Refresher - Formatting the Chart Area
1. Click anywhere on the chart area. 2. Click either the Home tab or the Format tab of the Chart Tools Ribbon. 3. Select any of the available formatting commands in these tabs.

Skill Refresher - Formatting the Plot Area
1. Click anywhere on the plot area. 2. Click either the Home tab or the Format tab of the Ribbon. 3. Select any of the available formatting commands in these tabs

Adding Series Lines and Annotations to a Chart

Follow-along file: Continue with Excel Objective 4.00. (Use file Excel Objective 4.13 if starting here.)

The last formatting features we will demonstrate are adding series lines and annotations to a chart. To demonstrate these skills, we will use the Change in Health Care Spend Source stacked column chart. Series lines are commonly used in stacked column charts to show the change from one stack to the next. Annotations are useful for clarifying the data presented in a chart or for identifying data sources. In addition to demonstrating these skills, we will review several of the formatting skills that were covered in this section. The following steps include the skills review as well as the new formatting features:

1. Locate the Change in Health Care Spend Source chart on the **Health Care** worksheet. Activate the chart by clicking anywhere inside the chart perimeter.
2. Move the chart to a separate chart sheet by clicking the Move Chart button in the Design tab of the Ribbon. Type the following sheet tab label in the New sheet input box: **Health Spending Chart**. Click the OK button.
3. Click anywhere on the X axis to activate it. In the Home tab of the Ribbon, change the font style to Arial, change the font size to 12 points, and select the bold command.
4. Activate the Y axis and apply the same formatting adjustments as stated in step 3.
5. Add a Y axis title by Clicking on Add Chart Element for the Chart Tools Design ribbon and selecting Axis titles, then Primary Vertical Axis.
6. In the Format tab under the Chart Tools section of the Ribbon, select the first preset style option, Colored Outline - Black, Dark 1, in the Shape Styles group of commands.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

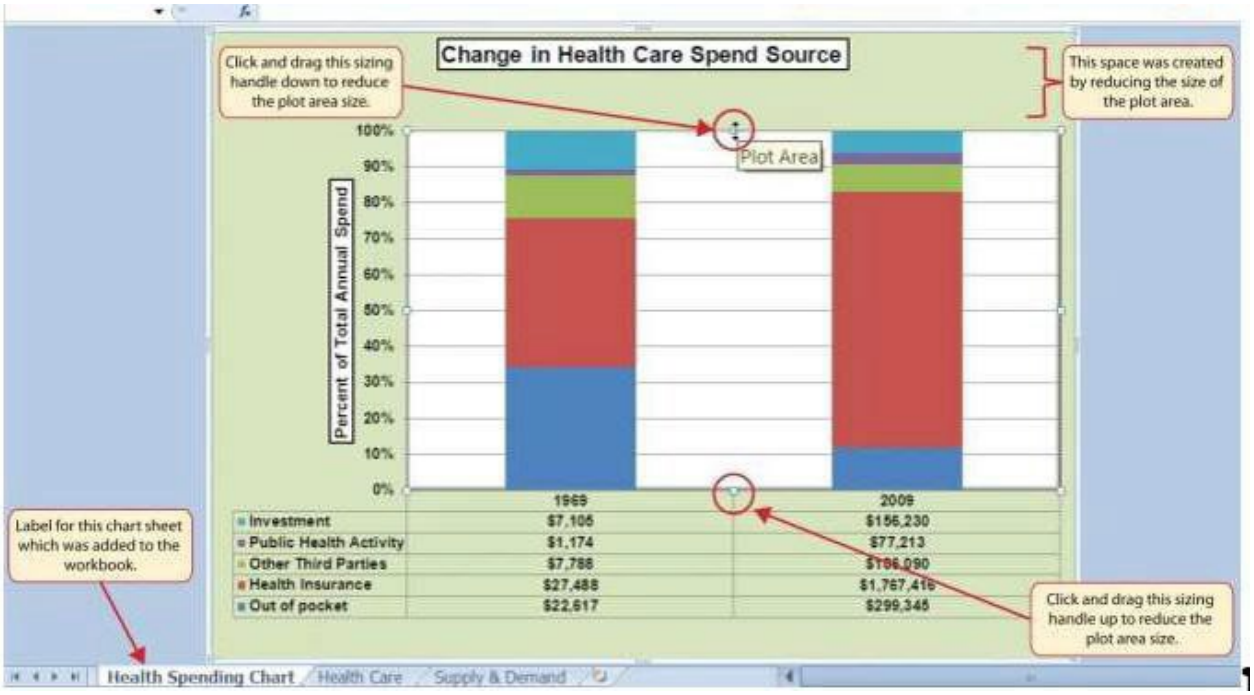
Then, in the Home tab of the Ribbon, change the font style to Arial and the font size to 14 points.

7. While the Axis Title is still selected, type **Percent of Total Annual Spend** in the Formula bar and then hit enter to save your changes.
8. Click and drag the vertical axis so it is closer to the plot area.
9. Activate the title of the chart by clicking it once. In the Format tab under the Chart Tools section of the Ribbon, select the first preset style option, Colored Outline - Black, Dark1, in the Shape Styles group of commands. Then, in the Home tab of the Ribbon, change the font style to Arial.
10. Activate the Chart Area by clicking on the down arrow next to the Format Selection box on the Format tab of the Chart Tools ribbon and selecting Chart Area.
11. Click the Format tab in the Chart Tools section of the Ribbon and click the down arrow on the Shape Fill button. Select the Olive Green, Accent 3, Lighter 60% option on the color palette. *Note: This will change the entire chart background to the color selected.*
12. Activate the plot area using the method in step 10.
13. Change the plot area shape fill to white.
14. Click the Shape Effects button in the Format tab of the Ribbon. Place the mouse pointer over the Bevel option from the drop-down menu. Select the first option from the Bevel format list, which is the “Round” bevel option.
15. Click and drag down the top center sizing handle of the plot area approximately 1/2 inch (see Figure 4.39 "Adjusting the Size of the Plot Area").
16. Click and drag up the bottom center sizing handle approximately three-quarters of an inch. This step and step 15 are necessary to create space at the top and bottom of the chart to add annotations.

Figure 4.39 "Adjusting the Size of the Plot Area" shows the Change in Health Care Spend Source chart prior to adding the series lines and annotations. The remaining steps will focus on adding lines and annotations:

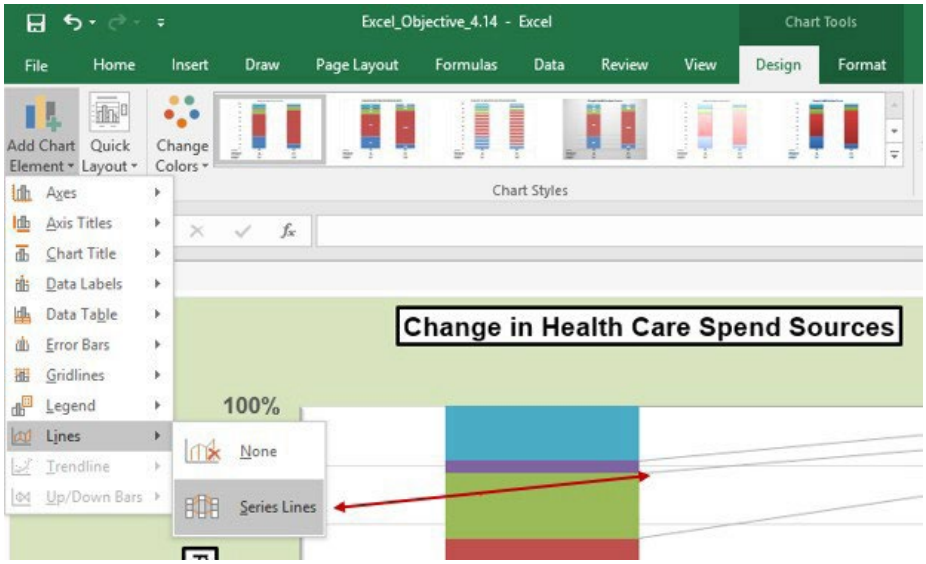
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.39 Adjusting the Size of the Plot Area



17. Click the Design tab in the Chart Tools section of the Ribbon.
18. Click the Add Chart Element, Lines, Click the Series Lines option from the drop-down list. This adds lines to the chart, connecting each data series between the two stacks (see Figure 4.40 "Selecting the Series Lines Option").

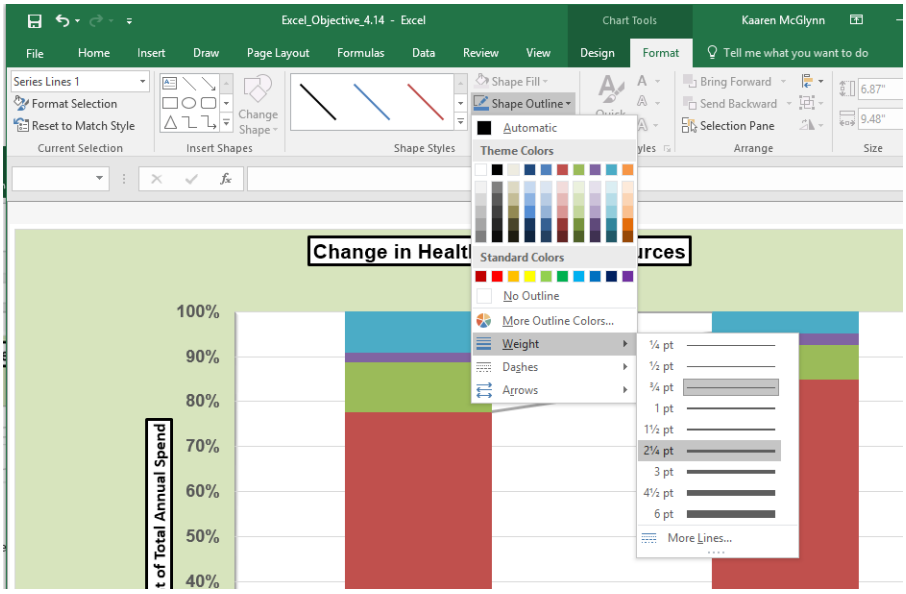
Figure 4.40 Selecting the Series Lines Option



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

19. Click any of the series lines added to the chart. Clicking one line will activate all lines on the chart. *Note: you can select the series lines the way you did earlier. Chart Tools, Format, select Series Line1 from the Format Selection box.*

Figure 4.41 Adding the Series Lines

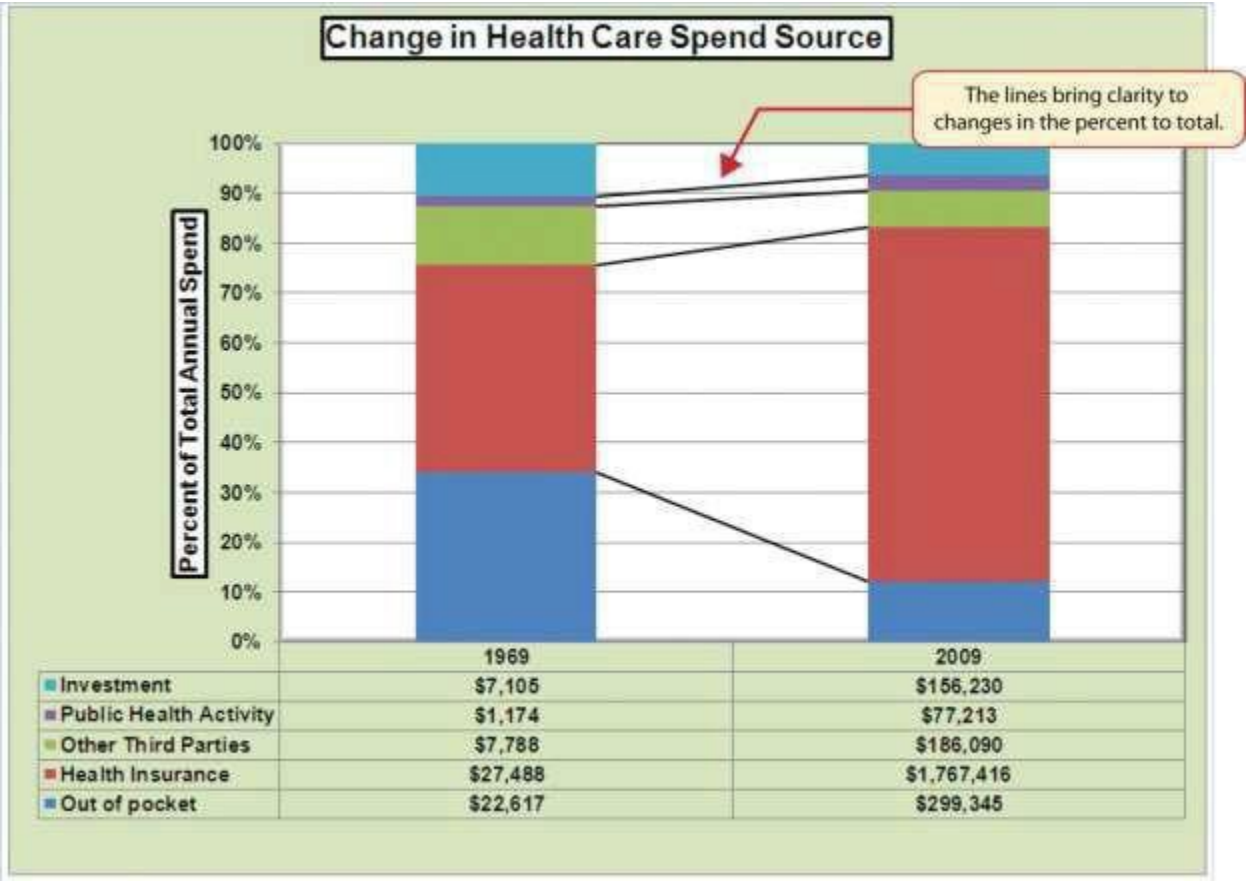


20. Click the Shape Outline button in the Format tab of the Ribbon. Place the mouse pointer over the Weight option and select the "2¼ line weight" option.

Figure 4.42 "Series Lines Added to the Stacked Column Chart" shows the appearance of the chart with the series lines connecting the two stacks. This formatting enhancement is common for stacked column charts. The lines help focus the audience's attention on changes in the percent of total trend. In this case, the audience can quickly see the decline in the Out-of-Pocket category (blue) and the increase in the Health Insurance category (red).

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.42 Series Lines Added to the Stacked Column Chart



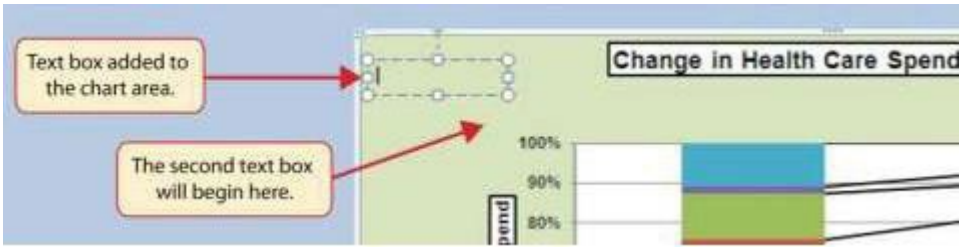
21. Click anywhere in the chart area of the Change in Health Care Spend Source chart.
22. Click the Text Box button in the Chart Tools Format Ribbon

23. Position the mouse pointer on the left edge of the chart area approximately one-quarter inch from the top. Click and drag a rectangle approximately one and a half inches wide and one-quarter inch high (see Figure 4.43 "Adding Annotations to the Stacked Column Chart").

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

24. Click the Home tab of the Ribbon and change the font style to Arial, change the font size to 10 points, and select the bold and italics commands.
25. Type **Dollars in Millions**. This tells the audience that the numbers have been truncated and represent denominations in millions. This means you would add six zeros to the end of each number on the chart. Therefore, the Out of Pocket value for 1975 is shown as $22,617 but is $22,617,000,000, or $22.6 billion.

Figure 4.43 Adding Annotations to the Stacked Column Chart

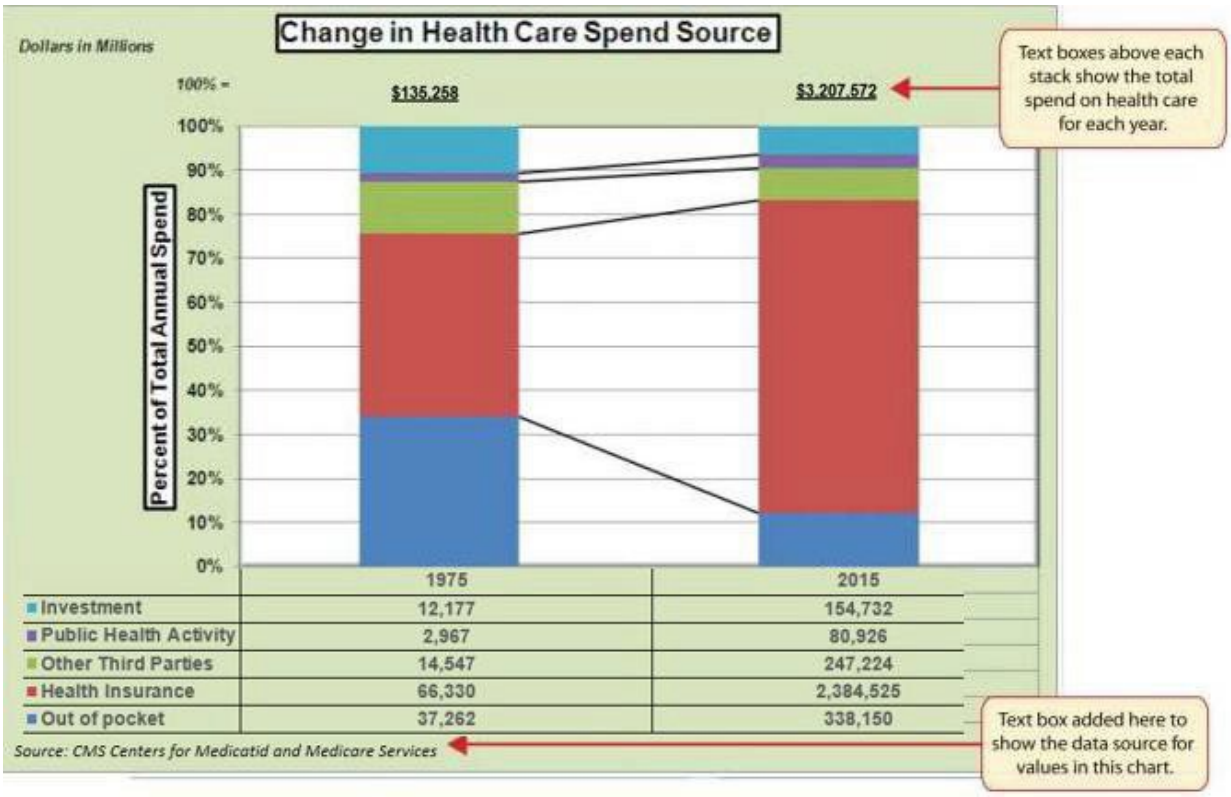


26. Repeat steps 19–22 to add a second text box to the chart. Begin drawing this text box below the first box approximately one inch in from the left edge of the chart Complete the formatting changes in step 22 and select the Align Text Right command.
27. Type **100% =** in the second textbox.
28. Repeat steps 19–22 to add a third text box to the chart. Center this text box over the 1975 stack. In addition to the formatting commands in step 22, select the Center align command and the Underline command.
29. Type **$66,172** in the third text box.
30. Repeat steps 19–22 to add a fourth text box to the chart. Center this text box over the 2015 stack. In addition to the formatting commands in step 22, select the Center align command and the Underline command.
31. Type **$2,486,293** in the fourth textbox.
32. Repeat steps 19–22 to add a fifth text box to the chart. Begin drawing this text box at the bottom left edge of the chart, just below the data table. The text box will need to be at least four inches wide.
33. Type **Source: CMS Centers for Medicaid and Medicare Services** in the fifth textbox.

Figure 4.44 "Completed Stacked Column Chart with Annotations" shows the completed Change in Health Care Spend Source stacked column chart. The lines and annotations provide key information for understanding the data and interpreting the trends presented on the chart.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.44 Completed Stacked Column Chart with Annotations



Integrity Check - Annotations and Axis Titles

Although adding annotations and axis titles can be a tedious process, doing so maintains a high level of integrity for your charts. People can misinterpret the message being conveyed by the chart if they make inaccurate assumptions about the values displayed. Axis titles and annotations help prevent readers from making false assumptions and ensure that readers see the most accurate representation of the message being conveyed by the chart.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Key Takeaways

- Applying appropriate formatting techniques is critical for making a chart easier to read.
- Many formatting commands in the Home tab of the Ribbon can be applied to a chart.
- To change the number format for a data label, you must use the Number section in the Format Data Labels dialog box. You cannot use the Number format commands in the Home tab of the Ribbon.
- To change the number format for the values on the Y axis, and the X axis in the case of a scatter chart, you must use the Number section of the Format Axis dialog box. You cannot use the Number format commands in the Home tab of the Ribbon.
- Axis titles and annotations help prevent false assumptions from being made and ensure that the reader sees the most accurate representation of the information presented on a chart.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

EXERCISES

1. You need to format the numbers along the Y axis of a column chart to US dollars with zero decimal places. Which of the following describes the method that would allow you to accomplish this?
   a. Activate the Y axis and use any of the number formatting commands in the Home tab of the Ribbon.
   b. Activate the Y axis and click the Data Labels button in the Add Chart Element of the Chart Tools Design Ribbon.
   c. Activate the Y axis and click the Format Selection button in the Format tab of the Chart Tools Ribbon.
   d. Activate the Y axis and click the Axis Titles button in the Layout tab of the Ribbon.
2. Which of the following statements is accurate regarding changing the color of a data series on a column chart?
   a. Right click one bar on the column chart plot area to activate all bars for that data series. Select Format Data Series from the drop-down. Click the Paint can in the Format Data Series, select Fill Color button and select a color.
   b. Click one bar on the column chart plot area twice to activate all bars for that data series. Click the Shape Fill button in the Format tab of the Ribbon and select a color.
   c. Click the Legend one time and then click the name of the data series to activate it. Click the Shape Fill button in the Format tab of the Ribbon and select a color.
   d. Both A and C are valid methods for changing the color of a data series.
3. Which of the following methods is accurate with respect to formatting the legend?
   a. Click the legend one time and use any of the available formatting commands in the Home tab of the Ribbon.
   b. Click the Legend button in the Layout tab of the Ribbon and select from the drop-down list of commands.
   c. Click the legend one time to activate it and use any of the formatting commands in the Design tab of the Ribbon.
   d. None of the above.
4. Which of the following is the most efficient way to add a title to the Y axis of a chart?
   a. Add a text box to the plot area and drag it over to the Y axis.
   b. Type the title into the formula bar. This adds a text box to the plot area that can be dragged over to the Y axis.
   c. Select the vertical axis option from the Add Chart Element button in the Design tab of the Chart Tools Ribbon.
   d. Select the axis title option in the Select Data Source dialog box after clicking the Select Data button in the Design tab of the Ribbon.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

4.3 The Scatter Chart

LEARNING OBJECTIVES
1. Construct a scatter chart to show the supply and demand curves for a market.
2. Learn how to adjust the scale of the X and Y axes of a scatter chart.
3. Add a trendline and line equation to a data series on a scatter chart.

This section focuses on the scatter chart type. What makes this chart different from the other charts demonstrated in this chapter is that values are used on both the X and Y axes. So far, the charts we have demonstrated in this chapter use categories or qualitative labels for the X axis. This means that the distance between each category on the X axis will always be the same, even if numbers are used. In a scatter chart, the X axis operates just like the Y axis. In other words, the distance between the values on the X axis will vary depending on the value of the number. Depending on the format, we can create the scatter chart to look just like a line chart. Since both the X and Y axes contain quantitative values, the scatter chart is a valuable tool for studying various shapes or functional forms for a line chart. In fact, a common feature used with the scatter chart is the trendline and equation. Excel can evaluate the line that is produced on a scatter chart and produce a mathematical equation. We will demonstrate these features in this section.

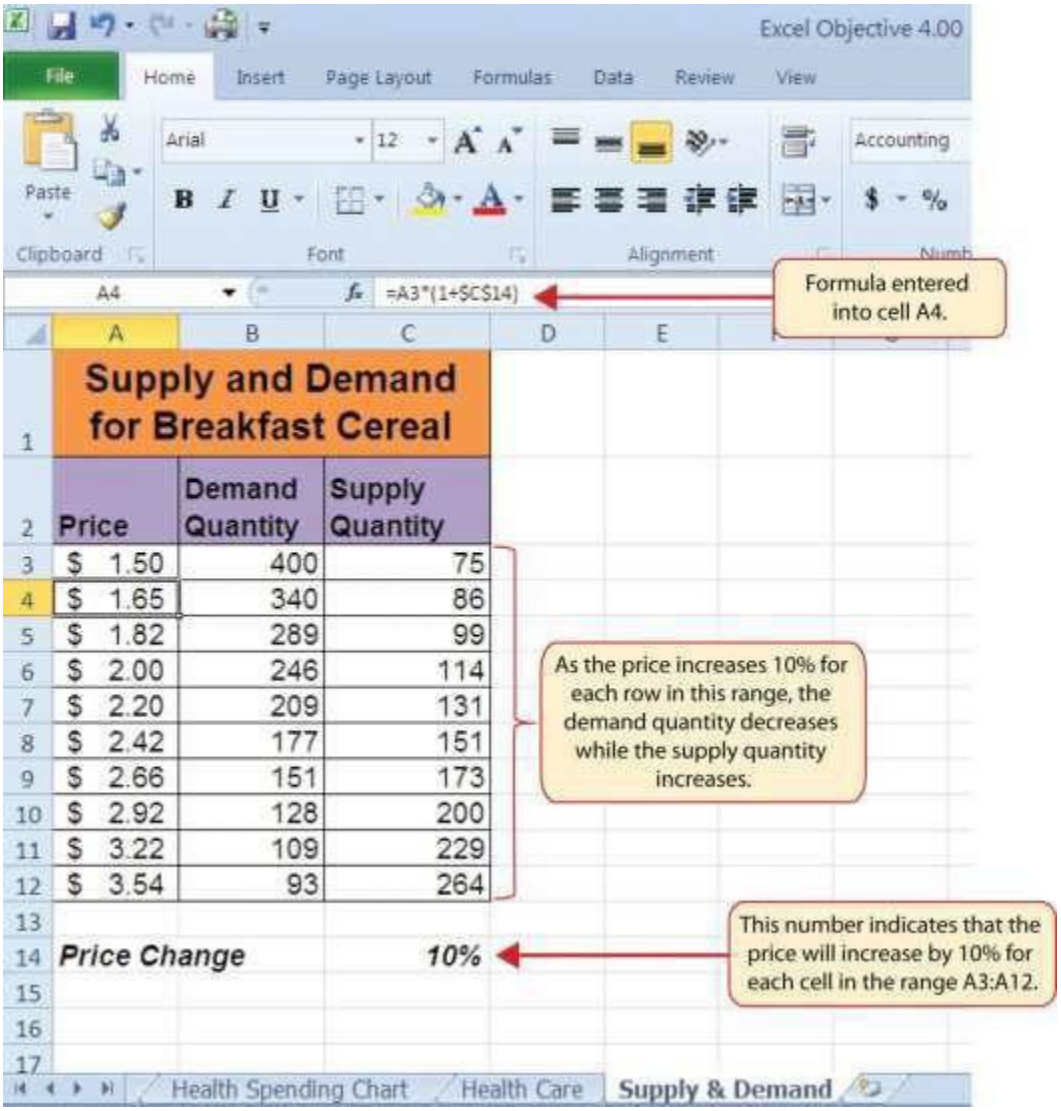
The Scatter Chart: Supply and Demand

Follow-along file: Continue with Excel Objective 4.00. (Use file Excel Objective 4.14 if starting here.)

A common use for a scatter chart is the study of supply and demand curves. This is because the data points for both the supply and demand lines require quantitative values on both the X and Y axes. The Y axis contains the price of a certain good or item; the X axis contains the quantity sold for that good or item. Fundamental economic laws state that as prices rise, sellers are willing to increase supply and sell more goods. However, the reverse is true for consumers. As prices rise, consumers purchase fewer goods. The **Supply & Demand** worksheet contains hypothetical data for the supply and demand of breakfast cereal. There are ten data points to show the change in supply and demand as the price changes in Column A. The values you see in Columns A through C are formula outputs that are driven by the percentage in cell C14. For example, if the percentage in cell C14 is changed to 10, each price listed in Column A will increase, as shown in Figure 4.45 "Hypothetical Supply and Demand Data".

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.45 Hypothetical Supply and Demand Data



The formula =A3*(1+$C$14) is multiplying the Price in A3 by 1 + the percent change in cell C14. Using 1 + % is the same as multiplying A3 by 110% (given the example in Figure 4.45.) If you only multiply by the price change percent, you will get just the percent increase amount. Not the price but the percent increase. In the above example, if you multiply by the price change percent only, you will get $.15. Not the new price after the increase has been applied.

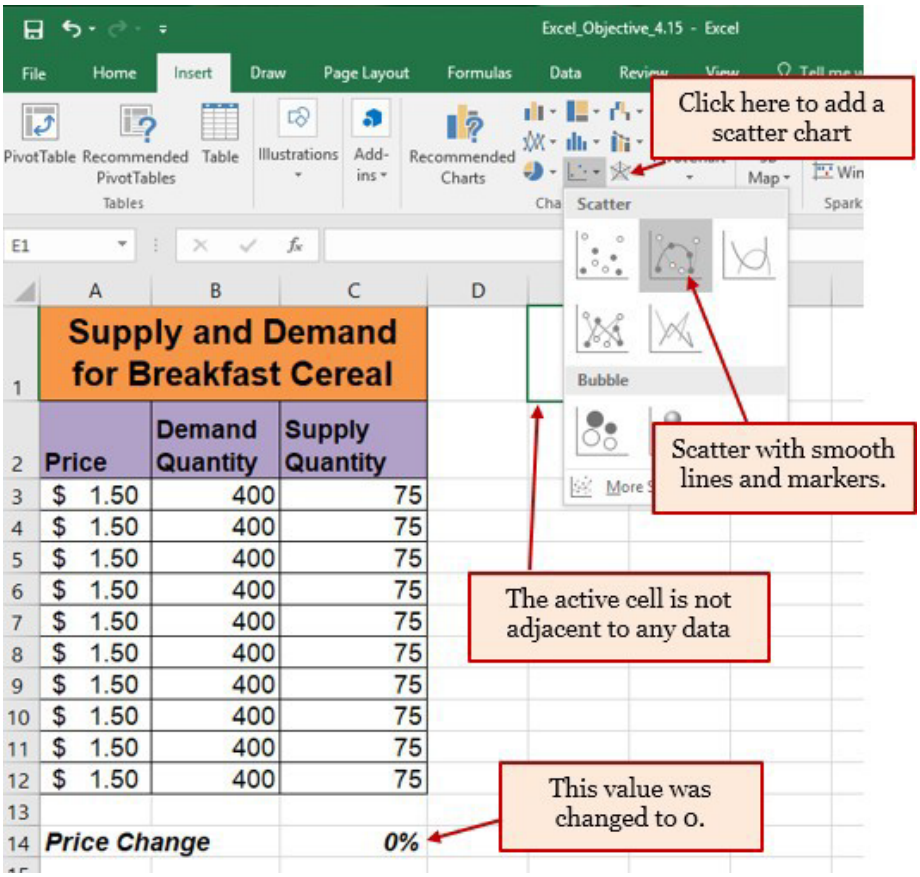
We will use the scatter chart to study the change in quantity supplied and demanded as the price increases over ten data points, as shown in Figure 4.45 "Hypothetical Supply and Demand Data". For many of the charts demonstrated in this chapter, we could highlight a range of cells and insert the chart type we needed. This was especially the case when the data was in a contiguous range of cells. However, this method rarely works when creating a scatter chart, even if the data are in a contiguous range. As a result, the method we

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

present here starts with a blank chart and demonstrates how each data series is added to the chart individually. The following steps explain how we create this chart:

1. Change the value in cell C14 on the **Supply & Demand** worksheet to zero.
2. Activate cell E1 on the **Supply & Demand** worksheet. It is important to note that this cell location is not adjacent to any data on the worksheet.
3. Click the Scatter button from the Charts group of commands on the Insert tab of the Ribbon.
4. Select the Scatter with Smooth Lines and Markers format from the drop-down list of options (see Figure 4.46 "Selecting a Scatter Chart Format"). This adds a blank chart to the worksheet.

Figure 4.46 Selecting a Scatter Chart Format

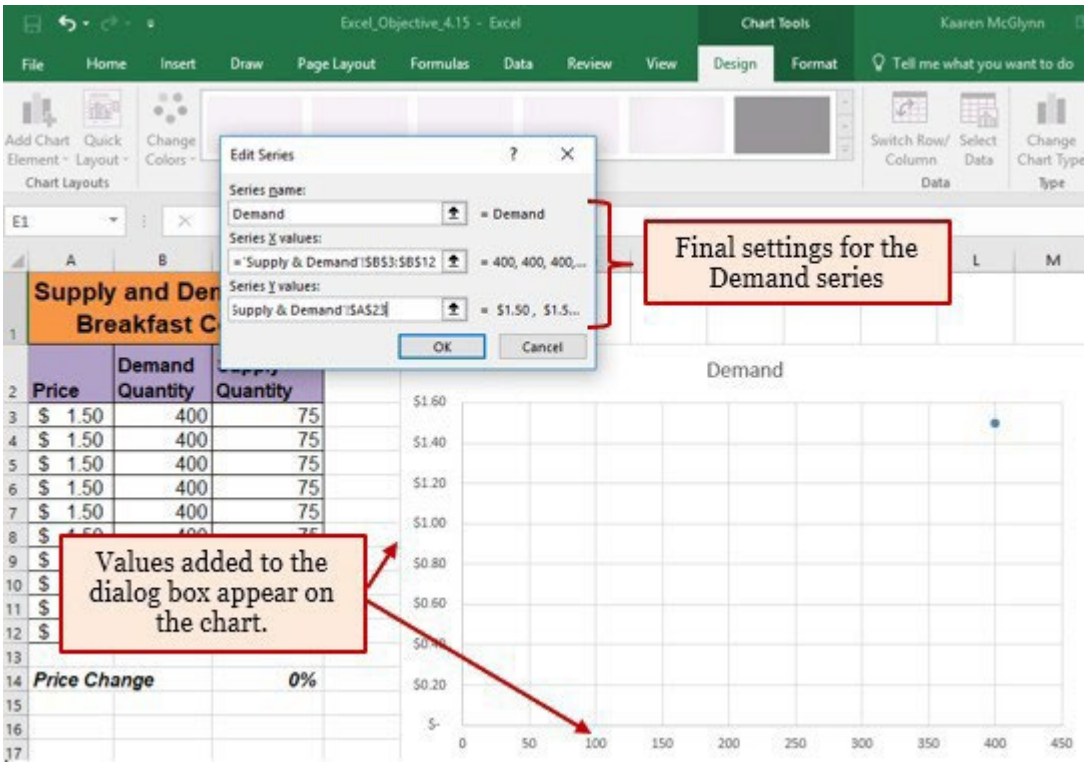


5. Click and drag the chart so the upper left corner is in the center of cell E2.
6. Resize the chart so the left side is locked to the left side of Column E, the right side is locked to the right side of Column M, the top is locked to the top of Row 2, and the bottom is locked to the bottom of Row 17.
7. Click the Design tab in the Chart Tools section of the Ribbon. Then click the Select Data button in the Data group of commands. This opens the Select Data Source dialog box.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

8. Click the Add button on the left side of the Select Data Source dialog box. This opens the Edit Series dialog box. Notice on this dialog box there are inputs for defining values for both the X and Y axes. Charts that we previously created using this method only had an input for putting values on the Y axis.
9. Type the series name **Demand**. This should appear in the Series name input box.
10. Press the TAB key on your keyboard to advance to the Series X values input box on the Edit Series dialog box.
11. Highlight the range B3:B12 on the **Supply & Demand** worksheet. You will see this range appear in the Series X values input box after it is highlighted.
12. Press the TAB key on your keyboard to advance to the Series Y values input box on the Edit Series dialog box.
13. Highlight the range A3:A12 on the **Supply & Demand** worksheet.
14. Figure 4.47 "Defining the Demand Data Series" shows the final settings in the Edit Series dialog box for the Demand data series. You will see that as the X and Y axis values are defined in the dialog box, they appear on the chart. The chart in this figure shows the price along the Y axis and quantity along the X axis.

Figure 4.47 Defining the Demand Data Series



15. Click the OK button at the bottom of the Edit Series dialog box.
16. Click the Add button on the left side of the Select Data Source dialog box.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

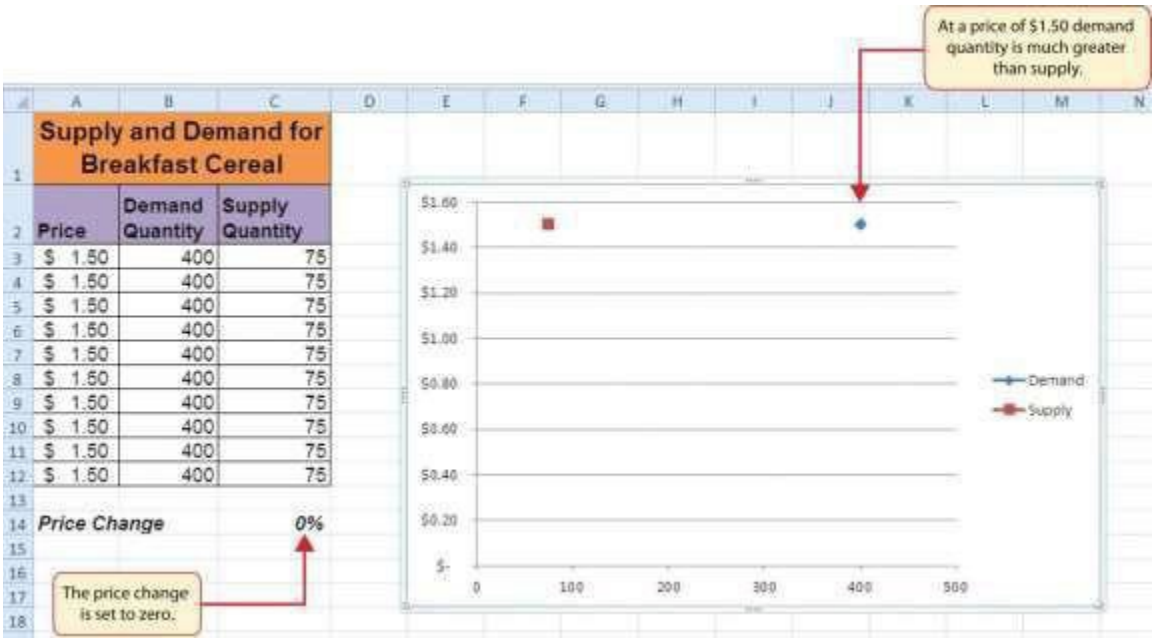
17. Type the series name **Supply**. This should appear in the Series name input box.
18. Press the TAB key on your keyboard to advance to the Series X values input box on the Edit Series dialog box.
19. Highlight the range C3:C12 on the **Supply & Demand** worksheet. This range appears in the Series X values input box after it is highlighted.
20. Press the TAB key on your keyboard to advance to the Series Y values input box on the Edit Series dialog box.
21. Highlight the range A3:A12 on the **Supply & Demand** worksheet.
22. Click the OK button at the bottom of the Edit Series dialog box.
23. Click the OK button at the bottom of the Select Data Source dialog box.

Why?
For Scatter Charts, Start with a Blank Chart When creating a scatter chart, it is best to start with a blank chart and add each data series individually. This is because Excel will not always guess correctly which values belong on the X and Y axes since both contain numbers. For other chart types, such as column or line charts, the X axis contains non-numeric data so it's easy for Excel to configure the chart you need.

Figure 4.48 "Scatter Chart Showing One Price" shows the appearance of the scatter chart before any formatting enhancements are applied. Notice only two plot points are located on the chart. This is because the price change value in cell C14 is still zero. Therefore, the data does not reflect any change in price, quantity demanded, or quantity supplied. The chart shows that at the current price of $1.50, suppliers are willing to provide fewer units compared with the number of units consumers are willing to buy.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.48 Scatter Chart Showing One Price



The following steps explain the formatting enhancements we will apply to the scatter chart shown in Figure 4.48 "Scatter Chart Showing One Price":

1. Add titles to the chart by clicking the Quick Layout drop down button on the Chart Tools Design Tab. Choose Layout 1
2. Click on the Chart Title to activate it. Select Subtle Effect - Orange, Accent 6 from the Theme Styles list in the Shape Styles group of commands on the Format tab of the Ribbon.
3. Change the font style of the chart title to Arial, bold, and the font size to 14 points.
4. Change the wording of the chart title as follows: **Supply and Demand for Breakfast Cereal**.
5. Click on the vertical Axis Title
6. Repeat steps 2 and 3 to format the Y axis title. However, change the font size to 12 points.
7. Change the wording of the Y axis title as follows: **Price per Unit**.
8. Click on the X Axis Title.
9. Repeat steps 2 and 3 to format the X axis title. However, change the font size to 12 points.
10. Change the wording of the X axis title as follows: **Quantity in Units**.

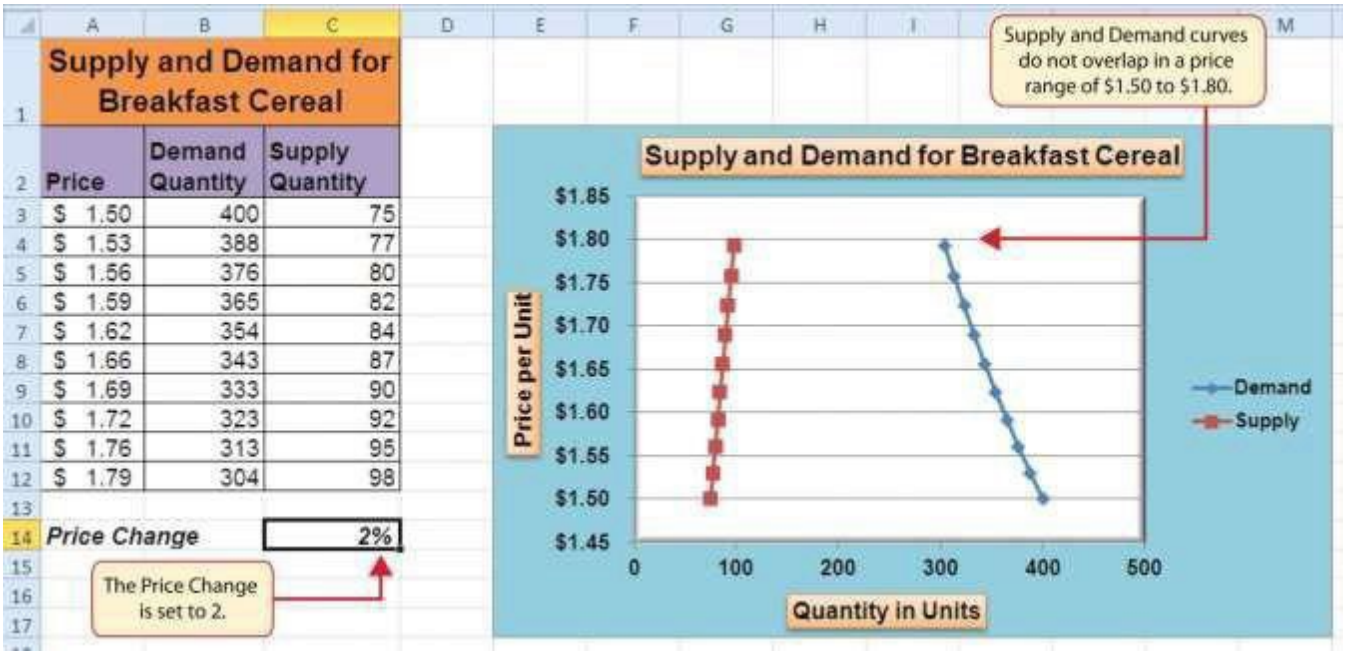
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

11. Change the color of the plot area back to white. *Note: if you don't change the color to white, when you do step 12 the entire chart will be Aqua Accent 5. You can always come back and change the plot area back to white if that happens.*
12. Change the color of the chart area to Aqua, Accent 5, Lighter 40%.
13. Apply a bevel effect to the plot area. Use the Circle format option from the Bevel drop-down list of options.
14. Change the font style of the legend to Arial and bold the font.
15. Change the value in cell C14 to 2. Then change it to 4 and then to 8. Change the value one more time to 14. As you change the values in cell C14, you will see the lines change on the chart.

Figure 4.50 "Scatter Chart with Price Change at 2%" shows the completed scatter chart when the Price Change is set to 2%, and Figure 4.51 "Scatter Chart with Price Change at 14%" shows the same chart when the Price Change is set to 14%. The point at which the demand and supply lines intersect on Figure 4.51 "Scatter Chart with Price Change at 14%" is known as the market equilibrium point.

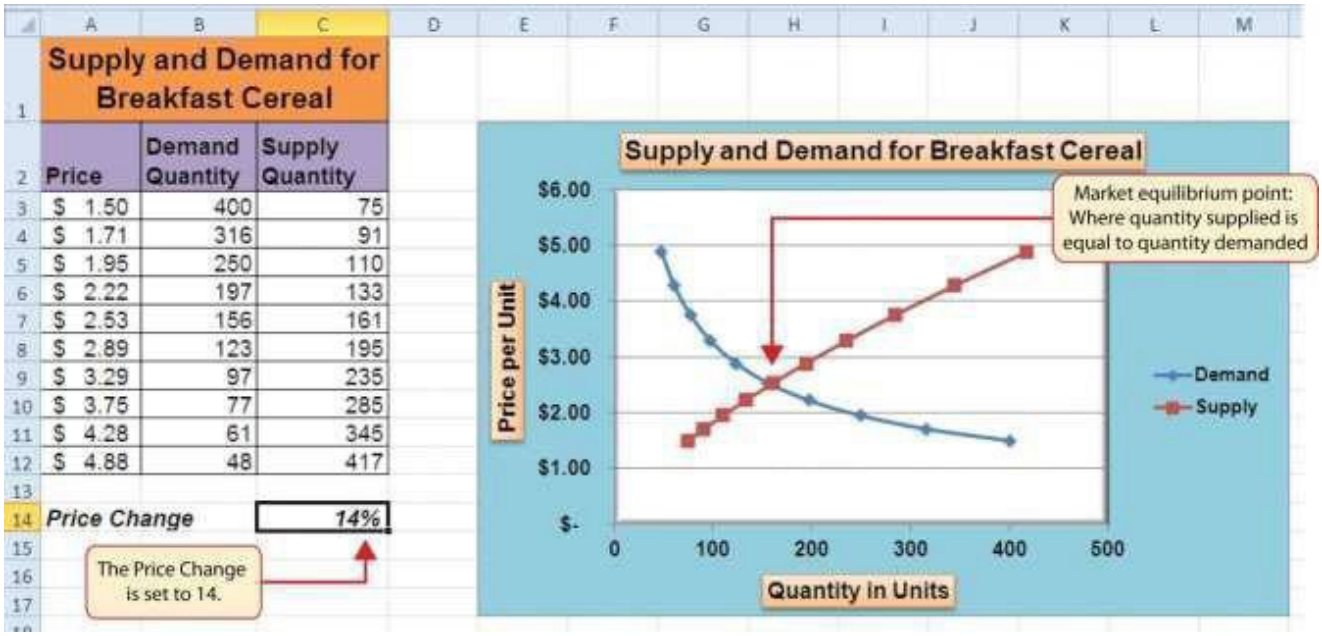
The market equilibrium is where the quantity demanded equals the quantity supplied at a specific price. The price where quantity demanded equals quantity supplied is referred to as the equilibrium price.

Figure 4.50 Scatter Chart with Price Change at 2%



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.51 Scatter Chart with Price Change at 14%



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Skill Refresher - Creating a Scatter Chart

1. Click a blank cell that is not adjacent to any data on the worksheet.
2. Click the Insert tab of the Ribbon.
3. Click the Scatter button in the Charts group of commands.
4. Select a format option from the drop-down list.
5. Move the blank chart off any cell locations containing data that will be used to create the chart.
6. Click the Select Data button in the Design tab of the Chart Tools section of the Ribbon.
7. Click the Add button on the Select Data Source dialog box.
8. Type a name for the data series in the Series name input box in the Edit Series dialog box.
9. Press the TAB key on your keyboard to advance to the Series X values input box.
10. Highlight the range of cells on your worksheet that contain values to be plotted on the X axis.
11. Press the TAB key on your keyboard to advance to the Series Y values input box.
12. Highlight the range of cells on your worksheet that contain values to be plotted on the Y axis.
13. Click the OK button in the Edit Series dialog box.
14. Repeat steps 7 through 13 for each data series you want to add to the chart.
15. Click the OK button at the bottom of the Select Data Source dialog box.

Changing the Scale of the X and Y Axes

Follow-along file: Continue with Excel Objective 4.00. (Use file Excel Objective 4.15 if starting here.)

For all the charts demonstrated in this chapter, Excel has automatically established the scale for the Y axis. For scatter charts, Excel has also established the scale for the X axis. The axis scale is the minimum and maximum value that appears on an axis. For example, in Figure 4.51 "Scatter Chart with Price Change at 14%", the Y axis scale is set to a minimum value of zero and a maximum value of 6.00. Although this is a very convenient feature of Excel, you may want to change the scale in some instances. If you change the value in cell C14 on the **Supply & Demand** worksheet, the lines jump or shift on the plot area of the

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

chart. This is because Excel keeps rearranging the scale of both the X and Y axes. When studying the shape of lines, it is best to set the scale so it does not change.

The following steps explain how to accomplish this:

1 Change the value in cell C14 on the **Supply & Demand** worksheet to zero.

2 Right click anywhere on the Y axis of the chart and select FormatAxis.

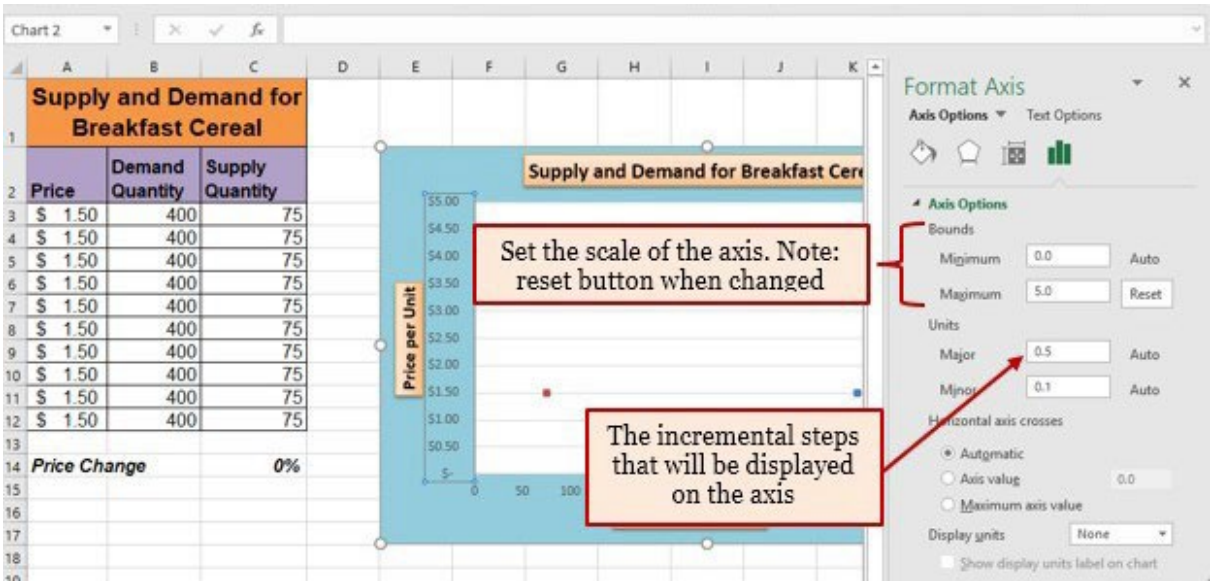
3 Click in the Maximum setting under the Axis Options in the Format Axis dialog box.

4 Click in the input box next to the Maximum setting. Remove the 1.6 and enter the number 5.0.

5 We will not be studying the behavior of supply and demand beyond a $5.00 price point, so there is no need to extend the Y axis beyond this point.

6 Click in the input box next to the Major Unit setting and change the value to 0.5 ifnot already set to 0.5. (see Figure 4.52 "Setting the Y Axis Scale"). This allows us to measure the plot points in $0.50 intervals along the Y axis.

Figure 4.52 Setting the Y Axis Scale



8. Click the X button at the top of the Format Axis dialog box.

9. Click anywhere along the X axis of thechart.

10. Click the Format Selection button in the Layout tab of the Chart Tools section of the Ribbon. This opens the Format Axis dialog box for the X axis.

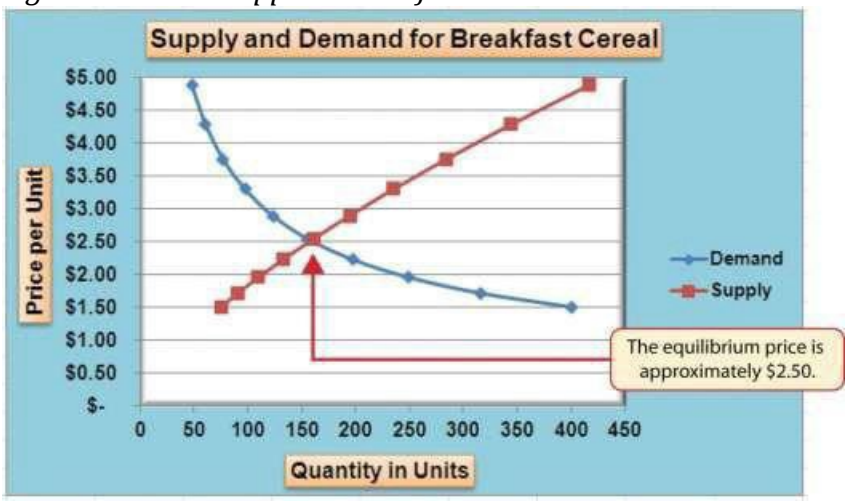
11. Click the Fixed option next to the Minimum setting under the Axis Options in the Format Axis dialog box. This ensures that the minimum value for the X axis will always be zero.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

12. Click the Fixed option next to the Maximum setting under the Axis Options in the Format Axis dialog box.
13. Click in the input box next to the Maximum setting. Remove the 500.0 and enter the number 450.0. The number of units supplied or demanded will not exceed 450 based on the price points in our study. There is no need to extend the X axis to 500.
14. Click the Fixed option next to the Major Unit setting under the Axis Options in the Format Axis dialog box.
15. Click in the input box next to the Major Unit setting and change the value from 100.0 to 50.0. This allows us to measure the plot points in 50-unit intervals along the X axis.
16. Click the Close button at the bottom of the Format Axis dialog box.
17. Change the value in cell C14 to 2. Then change it to 4 and then to 8. Change the value one more time to 14. As you change the values in cell C14, the lines change but they no longer jump or shift since the scale of both axes is fixed.

Figure 4.53 "Final Appearance of the Scatter Chart" shows the final appearance of the scatter chart after the scale is set for both the X and Y axes. Notice that market equilibrium is achieved at a price of approximately $2.50.

Figure 4.53 Final Appearance of the Scatter Chart



Adding a Trendline and Equation

Follow-along file: Continue with Excel Objective 4.00. (Use file Excel Objective 4.16 if starting here.)

A trendline can be applied to a chart to estimate or predict where plot points may occur at various points along the X and Y axes. Excel enables you to add a trendline to a chart and provides the equation you can use to plot additional points. The following steps explain how to accomplish this:

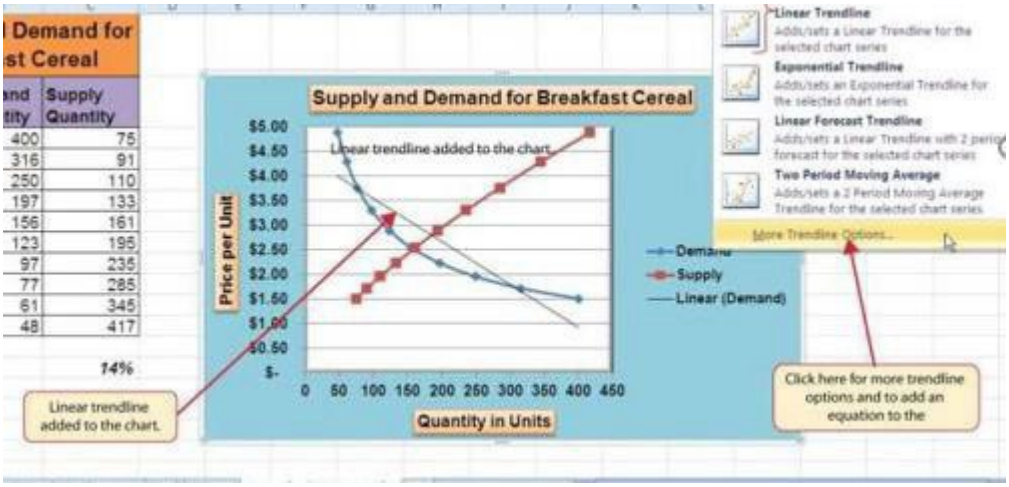
1. Set the value in cell C14 on the **Supply & Demand** worksheet to 14.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

2. Click anywhere in the chart area of the scatter chart to activate it.
3. Click the Add Chart Element button in the Design tab of the Chart Tools and select Trendline from the drop-down menu. Select the Linear Trendline option from the drop-down list.
4. Select the Demand option from the Add Trendline dialog box and click the OK button. This adds a new line to the plot area of the chart as well as the legend.
5. Figure 4.54 "Adding a Linear Trendline" shows the scatter chart after adding a linear trendline.

Notice that the line goes through only two points on the demand line. This indicates that this Trendline may *not* be a good fit for the line that has been created on the chart.

Figure 4.54 Adding a Linear Trendline



6. Finding the right shape for a trendline may require trying a few different options. As shown in Figure 4.54 "Adding a Linear Trendline", the linear trendline is not a good fit for the shape of the demand line. The remaining steps will demonstrate how to remove a trendline and access more trendline options:
7. Click the Trendline button in the Layout tab of the Ribbon. Select the None option from the drop- down list. This removes the trendline from the chart.
8. Click the Trendline button in the Layout tab of the Ribbon again. *Note: You must remove a trendline because clicking on other trendlines will add them to your chart with the one you already have created.* This time, select More Trendline Options from the drop-down list.
9. Select the Demand option from the Add Trendline dialog box and click OK. This opens the Format Trendline dialog box.
10. Select the Power option from the Format Trendline dialog box.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

11. Click the "Display Equation on chart" option at the bottom of the Format Trendline dialog box (see Figure 4.55 "The Format Trendline Dialog Box").

12. Click the Close button at the bottom of the Format Trendline dialog box.

Figure 4.55 The Format Trendline Dialog Box

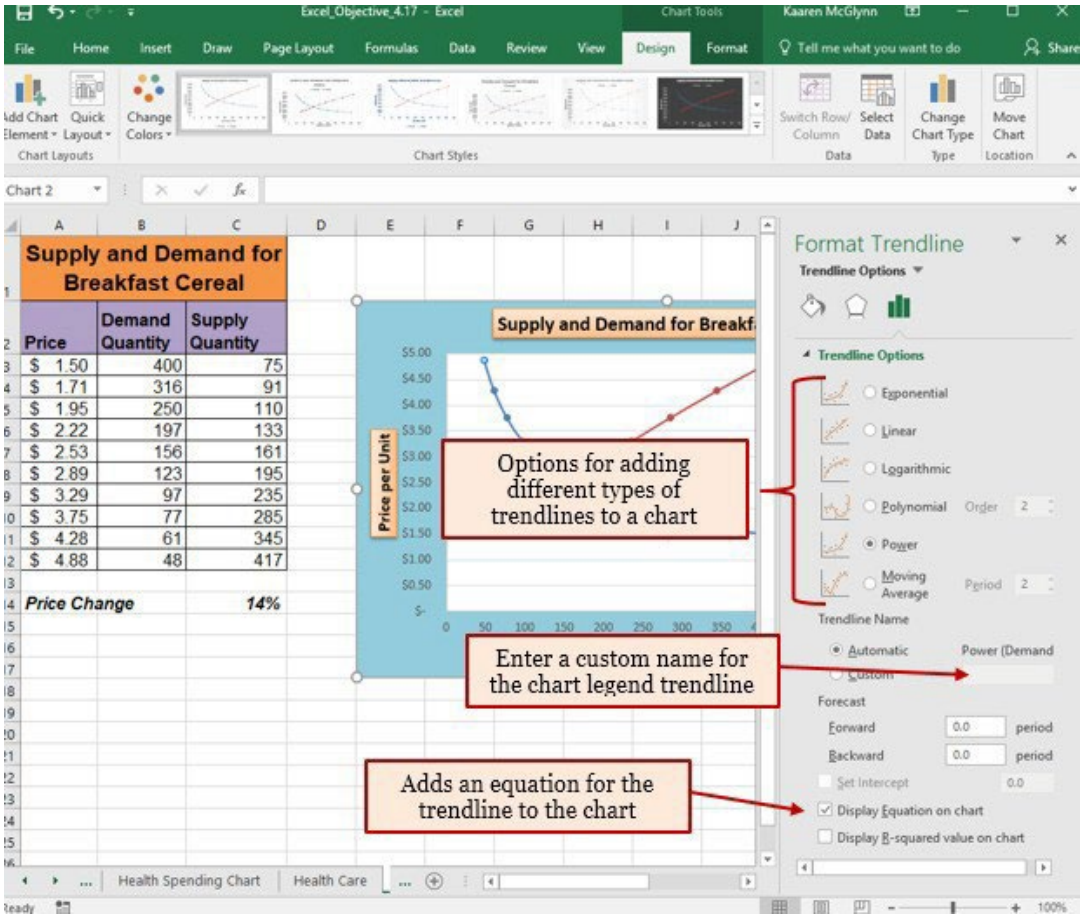
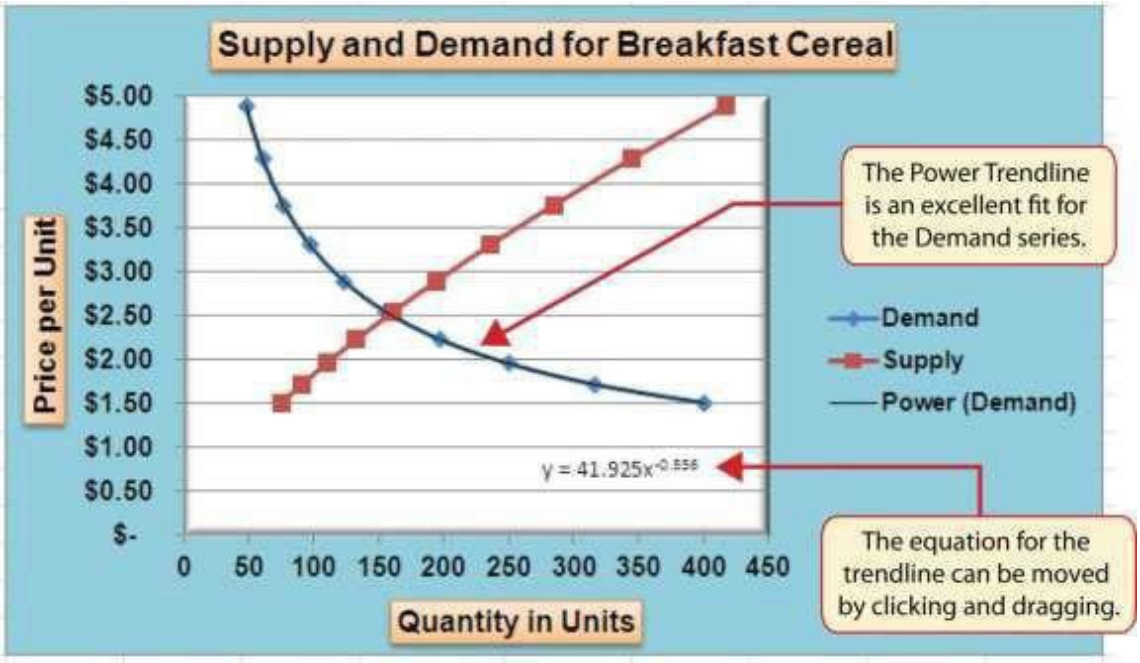


Figure 4.56 "Scatter Chart with a Power Trendline" shows the scatter chart with the Power trendline added for the demand series. Notice that the line fits perfectly over the demand series in the plot area. In fact, it may be difficult to see the line in the figure. This indicates that the trendline is an excellent fit for the demand line. As a result, we can be confident in using this line to predict other demand values along the X and Y axes. You can also see that the equation for this trendline has been added to the plot area of the chart. We can use the equation to calculate the price for each quantity value substituted for X. For example, if the number 150 is substituted for X in the equation, the result is a price of $2.59. Based on the values used to create the chart, this result appears to be accurate.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.56 Scatter Chart with a Power Trendline



Skill Refresher - Adding a Trendline

1. Click anywhere on the chart area.
2. Click Add Chart Element.
3. Select Trendline from the drop-down menu.
4. Select one of the preset trendline options from the drop-down list or select More Trendline Options to open the Add Trendline dialog box.
5. Select a data series in the Add Trendline dialog box and click the OK button.
6. Select the "Display Equation on chart" option from the Format Trendline dialog box to add the trendline equation to the chart.
7. Click the Close button at the bottom of the dialog box.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Key Takeaways

- When creating a scatter chart, it is best to start with a blank chart and add each data series individually. The highlight and click method is less reliable since numeric values are assigned to both the X and Y axes. As a result, Excel often guesses incorrectly which values are assigned to the X and Y axes.
- Finding the best fit for a trendline is often a matter of trial and error. You may have to try a few different
- trendlines to determine which form is the best fit for your data series.
- You must open the Format Trendline dialog box to add the line equation to the plot area of the chart.

EXERCISES

1. Which of the following is the best chart type to use if you need to create a line chart where both the X and Y axes contain numeric values?
   a. line chart
   b. scatter chart
   c. either a line chart or a scatter chart
   d. area chart
2. Which of the following methods allows you to set the scale of the Y axis?
   a. Activate the Y axis and click the Scale button in the Page Layout tab of the Ribbon.
   b. Activate the Y axis and click the Format Selection button in the Layout tab of the Ribbon.
   c. Activate the Y axis and click the Axes button in the Layout tab of the Ribbon; select the Primary Vertical Axis option and then select More Primary Vertical Axis Options.
   d. Both B and C are correct.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

4.4 Using Charts with Microsoft® Word® and PowerPoint®

Objectives
1. Learn how to paste an image of an Excel chart into a Word document. 2. Learn how to paste a link to an Excel chart into a PowerPoint slide.

Charts that are created in Excel are commonly used in Microsoft Word documents or for presentations that use Microsoft PowerPoint slides. Excel provides options for pasting an image of a chart into either a Word document or a PowerPoint slide. You can also establish a link to your Excel charts so that if you change the data in your Excel file, it is automatically reflected in your Word or PowerPoint files. We will demonstrate both methods in this section.

Pasting a Chart Image into Word

Follow-along Word file: Excel Objective 4.17

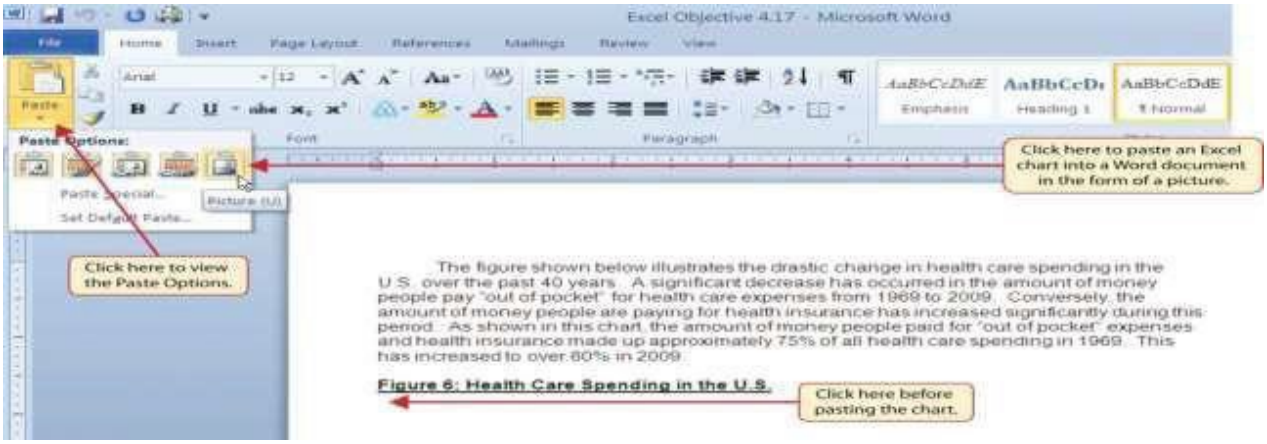
Excel charts can be valuable tools for explaining quantitative data in a written report. Reports that address business plans, public policies, budgets, and so on all involve quantitative data. For this example, we will assume that the Change in Health Care Spend Source stacked column chart (see Figure 4.44 "Completed Stacked Column Chart with Annotations") is being used in a written policy report. The following steps demonstrate how to paste an image, or picture, of this chart into a Word document:

1. Click below the figure heading in the Word document that reads: *Figure 6: Health Care Spending in the U.S.* The image of the stacked column chart will be placed below this heading.
2. Open the Excel Objective 4.16 follow-along file.
3. Activate the Change in Health Care Spend Source chart in the **Health Spending Chart** worksheet.
4. Click the Copy button in the Home tab of the Ribbon.
5. Go back to the Excel Objective 4.17 Word document by clicking the file in the taskbar.
6. Click the drop-down arrow below the Paste button in the Home tab of the Ribbon. Click the Picture option from the drop-down list, which is the last option on the far right (see Figure 4.57 "Paste Picture Option for Word").
7. Click anywhere on the picture of the chart to activate it.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

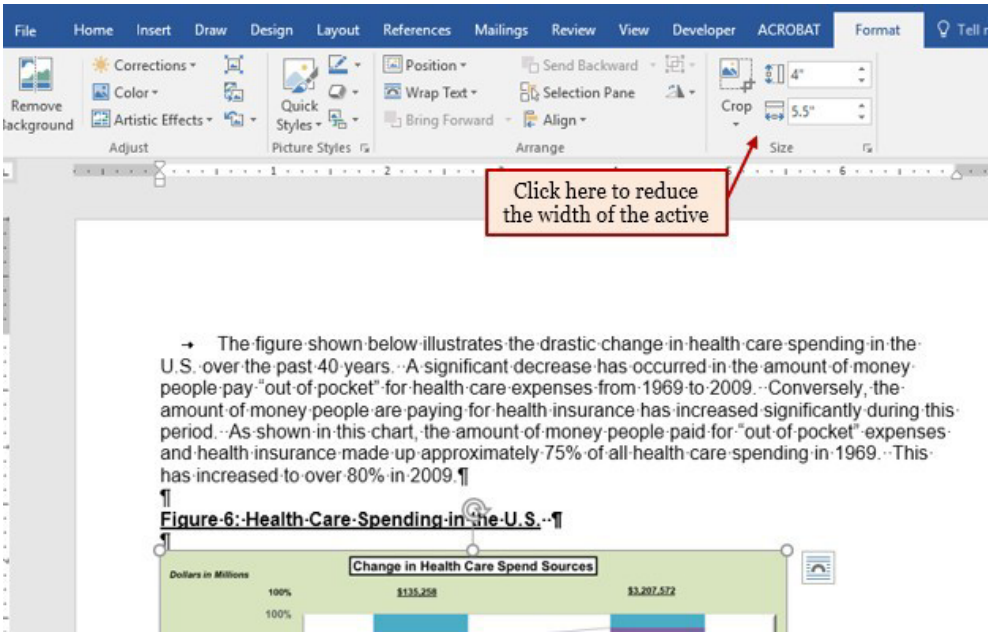
8. Click the Format tab under the Picture Tools section of the Ribbon (see Figure 4.58 "Changing the Size of a Picture in Word").

Figure 4.57 Paste Picture Option for Word


Excel Objective 4.17 - Microsoft Word
Paste Options:
Click here to view the Paste Options.
Click here to paste an Excel chart into a Word document in the form of a picture.
The figure shown below illustrates the drastic change in health care spending in the U.S. over the past 40 years. A significant decrease has occurred in the amount of money people pay "out of pocket" for health care expenses from 1969 to 2009. Conversely, the amount of money people are paying for health insurance has increased significantly during this period. As shown in this chart, the amount of money people paid for "out of pocket" expenses and health insurance made up approximately 75% of all health care spending in 1969. This has increased to over 80% in 2009.
Figure 6: Health Care Spending in the U.S.
Click here before pasting the chart.

9. Click the down arrow on the Shape Width button in the Size group of commands (see Figure 4.58 "Changing the Size of a Picture in Word"). Continue to click the down arrow until the width of the picture is 5.5. As you reduce the width of the picture, the height is automatically reduced as well.

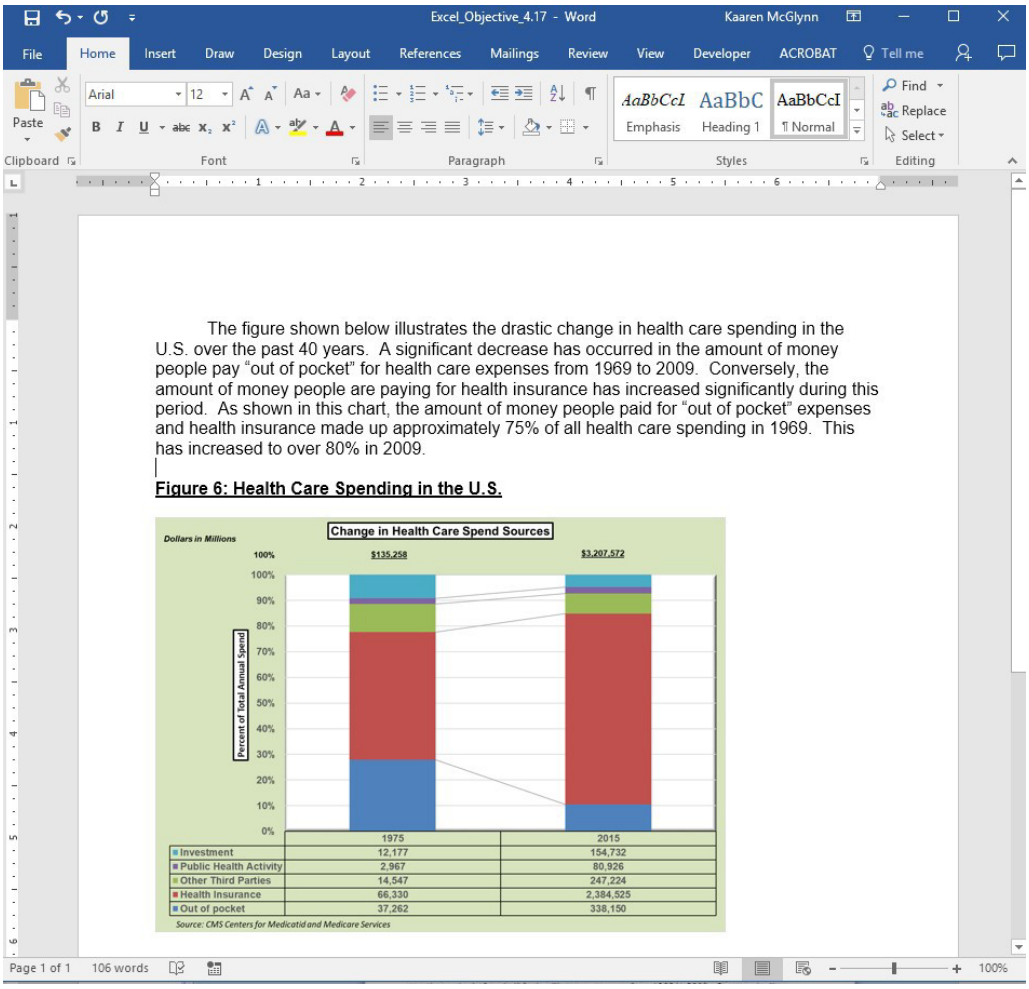
Figure 4.58 Changing the Size of a Picture in Word


File Home Insert Draw Design Layout References Mailings Review View Developer ACROBAT Format
Remove Background
Corrections
Color
Artistic Effects
Quick Styles
Position
Wrap Text
Bring Forward
Send Backward
Selection Pane
Align
Crop
4"
5.5"
Adjust
Picture Styles
Arrange
Size
Click here to reduce the width of the active
The figure shown below illustrates the drastic change in health care spending in the U.S. over the past 40 years. A significant decrease has occurred in the amount of money people pay "out of pocket" for health care expenses from 1969 to 2009. Conversely, the amount of money people are paying for health insurance has increased significantly during this period. As shown in this chart, the amount of money people paid for "out of pocket" expenses and health insurance made up approximately 75% of all health care spending in 1969. This has increased to over 80% in 2009.
Figure 6: Health Care Spending in the U.S.
Change in Health Care Spend Sources
Dollars in Millions
100%
$135,258
$3,207,572
100%

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.59 "Final Appearance of Pasting a Chart Image into Word" shows the final appearance of the Change in Health Care Spend Source chart pasted into a Word document. It is best to use either the Shape Width or Shape Height buttons to reduce the size of the chart. Using either button automatically reduces the height and width of the chart in proper proportion. If you choose to use the sizing handles to resize the chart, holding the SHIFT key while clicking and dragging on a corner sizing handle will also keep the chart in proper proportion.

Figure 4.59 Final Appearance of Pasting a Chart Image into Word


Excel_Objective_4.17 - Word
Kaaren McGlynn
The figure shown below illustrates the drastic change in health care spending in the U.S. over the past 40 years. A significant decrease has occurred in the amount of money people pay "out of pocket" for health care expenses from 1969 to 2009. Conversely, the amount of money people are paying for health insurance has increased significantly during this period. As shown in this chart, the amount of money people paid for "out of pocket" expenses and health insurance made up approximately 75% of all health care spending in 1969. This has increased to over 80% in 2009.
Figure 6: Health Care Spending in the U.S.
Change in Health Care Spend Sources
Dollars in Millions
$135.258
$3,207.572
Percent of Total Annual Spend
1975
2015
Investment 12,177 154,732
Public Health Activity 2,967 80,926
Other Third Parties 14,547 247,224
Health Insurance 66,330 2,384,525
Out of pocket 37,262 338,150
Source: CMS Centers for Medicatid and Medicare Services
Page 1 of 1
106 words

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Skill Refresher - Pasting a Chart Image into Word
1. Activate an Excel chart and click the Copy button in the Home tab of the Ribbon. 2. Click on the location in the Word document where the Excel chart will be pasted. 3. Click the down arrow of the Paste button in the Home tab of the Ribbon. 4. Click the Picture option from the drop-down list. 5. Click the Format tab in the Picture Tools section of the Ribbon. 6. Resize the picture by clicking the up or down arrow on the Shape Width or Shape Height buttons.

Integrity Check
Remember when copying and pasting an image into Word or PowerPoint that the image is not dynamically linked to your Excel document. If your numbers change in your Excel document, you must copy and paste the image again.

Pasting a Linked Chart Image into PowerPoint

Follow-along PowerPoint file: Excel Objective 4.18

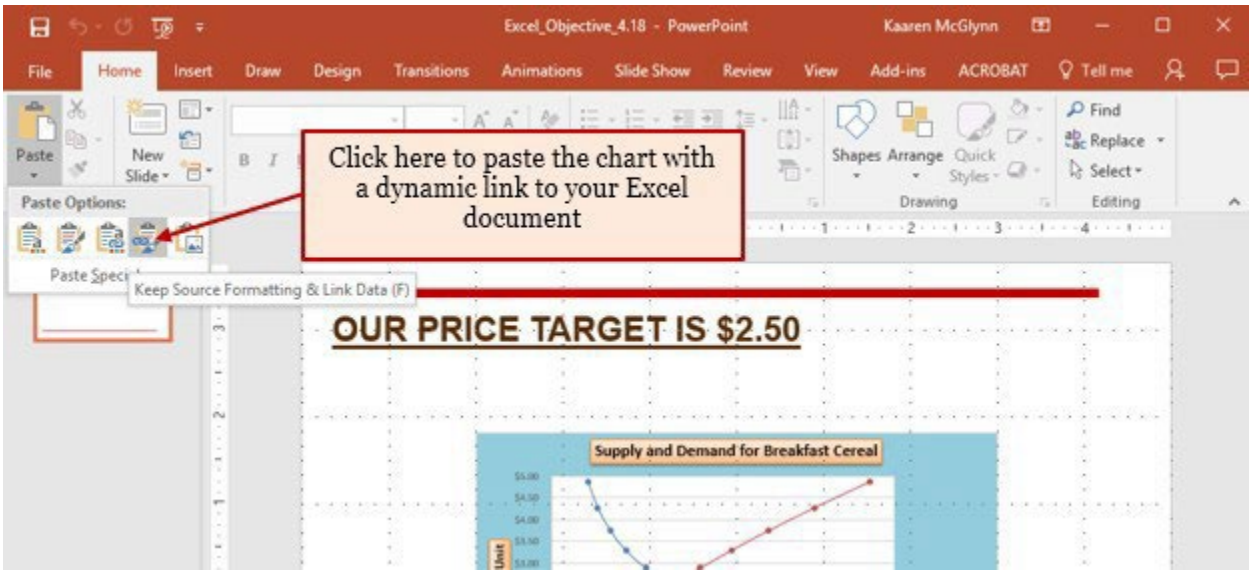
Microsoft PowerPoint is perhaps the most used tool for delivering live presentations. The charts used in a live presentation are critical for efficiently delivering your ideas to an audience. Like written documents, a wide range of presentations may require the explanation of quantitative data. This demonstration includes a PowerPoint slide that could be used in a presentation for setting prices for a hypothetical breakfast cereal company. We will paste the scatter chart showing the supply and demand for breakfast cereal into this PowerPoint slide. However, instead of pasting an image, as demonstrated in the Word document, we will establish a link to the Excel file. As a result, if we change the chart in the Excel file, the change will be reflected in the PowerPoint file. The following steps explain how to accomplish this:

1. Open the Excel Objective 4.16 follow-along file.
2. Activate the scatter chart in the **Supply & Demand** worksheet.
3. Click the Copy button in the Home tab of the Ribbon.
4. Go back to the Excel Objective 4.18 PowerPoint file by clicking the file in the taskbar.
5. Click the down arrow below the Paste button in the Home tab of the Ribbon in the PowerPoint file.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

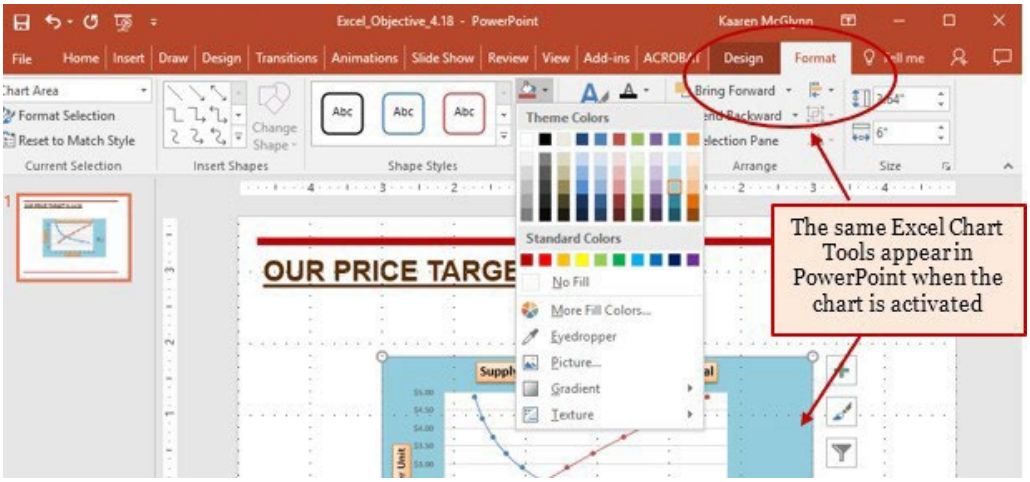
6. Select the Keep Source Formatting & Link Data option from the drop-down list (see Figure 4.60 "Creating a Link to an Excel Chart in PowerPoint"). This pastes an image of the Excel chart into the PowerPoint slide. In addition, a link is created so that any changes made to the chart appear on the PowerPoint slide.

Figure 4.60 Creating a Link to an Excel Chart in PowerPoint


Excel_Objective_4.18 - PowerPoint
Kaaren McGlynn
Click here to paste the chart with a dynamic link to your Excel document
Paste Options:
Keep Source Formatting & Link Data (F)
OUR PRICE TARGET IS $2.50
Supply and Demand for Breakfast Cereal

7. Click anywhere in the plot area of the scatter chart pasted into the PowerPoint slide. You will see the same Excel Chart Tools tabs added to the Ribbon (see Figure 4.61 "Modifying an Excel Chart Pasted into a PowerPoint Slide").

Figure 4.61 Modifying an Excel Chart Pasted into a PowerPoint Slide



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

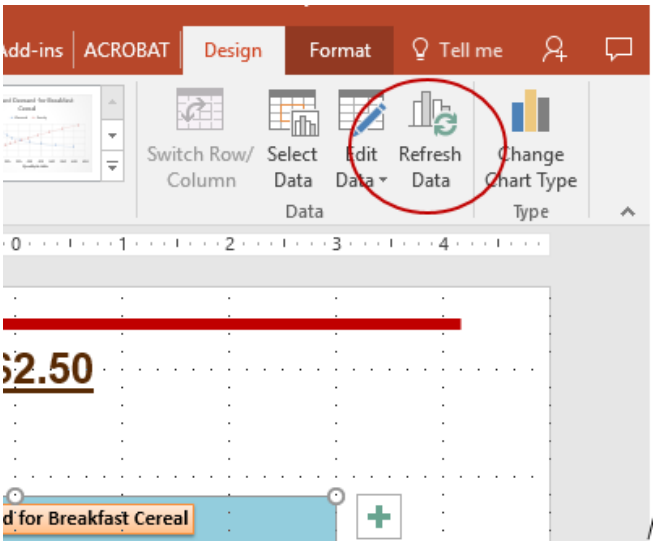
8. Click the down arrow next to the Shape Fill button in the Format tab of the Ribbon. Select the white color block from the palette (see Figure 4.61 "Modifying an Excel Chart Pasted into a PowerPoint Slide").
9. Go back to the Excel Objective 4.16 file by clicking it in the taskbar.
10. In the **Supply & Demand** worksheet, change the value in cell C14 to 6.
11. Go back to the Excel Objective 4.18 PowerPoint file by clicking it in the taskbar.
12. Click the Design tab in the Chart Tools section of the Ribbon. Click the Refresh Data button (see Figure 4.62 "Refreshing a Linked Excel Chart Pasted into a PowerPoint Slide"). The change made in the Excel workbook is now reflected on the PowerPoint slide.

Integrity Check - Refreshing Linked Charts in PowerPoint and Word

When creating a link to a chart in Word or PowerPoint, you must refresh the data if you make any changes in the Excel workbook. This is especially true if you make changes in the Excel file prior to opening the Word or PowerPoint file that contains a link to a chart. To refresh the chart, save the Excel file after the changes, in PowerPoint, activate the chart, then click the Refresh Data button in the Design tab of the Ribbon. Forgetting this step can result in old or erroneous data being displayed on the chart.

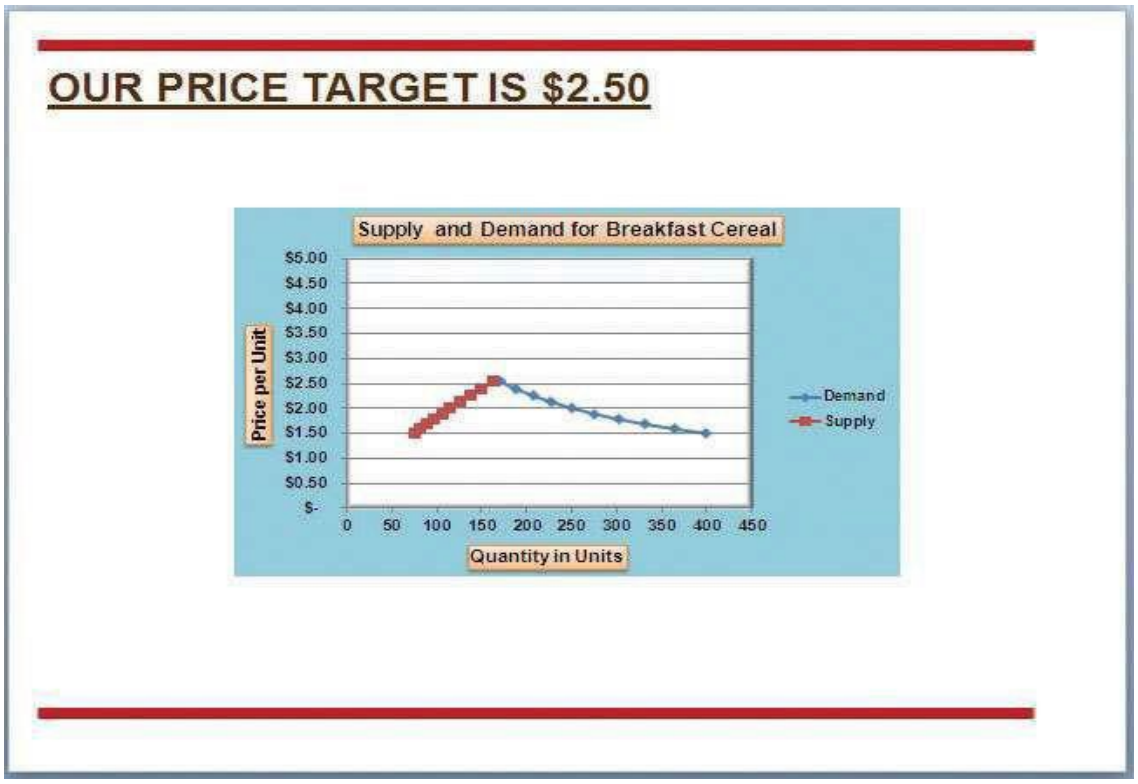
Figure 4.62 "Refreshing a Linked Excel Chart Pasted into a PowerPoint Slide "shows the appearance of the scatter chart in the PowerPoint slide after the color of the plot area was changed back to white. Figure 4.63 "Final Chart Linked to a PowerPoint Slide" shows the appearance of the scatter plot after the change was made in the Supply & Demand worksheet in the Excel file. The change that was made in the Excel file will appear in the PowerPoint file after clicking the Refresh Data button.

Figure 4.62 Refreshing a Linked Excel Chart Pasted into a PowerPoint Slide



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.63 Final Chart Linked to a PowerPoint Slide



Integrity Check - Severed Link?

When creating a link to an Excel chart in Word or PowerPoint, you must keep the Excel workbook in its original location on your computer or network. If you move or delete the Excel workbook, you will get an error message when you try to update the link in your Word or PowerPoint file. You will also get an error if the Excel workbook is saved on a network drive that your computer cannot access. These errors occur because the link to the Excel workbook has been severed. Therefore, if you know in advance that you will be using a USB drive to pull up your documents or presentation, move the Excel workbook to your USB drive before you establish the link in your Word or PowerPoint file.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Skill Refresher - Pasting a Linked Chart Image into PowerPoint

1. Activate an Excel chart and click the Copy button in the Home tab of the Ribbon.
2. Click in the PowerPoint slide where the Excel chart will be pasted.
3. Click the down arrow of the Paste button in the Home tab of the Ribbon.
4. Click the Keep Source Formatting & Link Data option from the drop-down list.
5. Click the Refresh Data button in the Design tab of the Ribbon to ensure any changes in the Excel file are reflected in the chart.

Key Takeaways

- When pasting an image of an Excel chart into a Word document or PowerPoint file, use the Picture option from the Paste drop-down list of options.
- When creating a link to a chart in Word or PowerPoint, you must refresh the data if you make any changes in the Excel workbook.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

EXERCISES

1. When pasting an image of an Excel chart into a Word document, which of the following commands would you use?
   a. Click the Paste button in the Home tab of the Ribbon.
   b. Click the down arrow below the Paste button in the Home tab of the Ribbon, and select the Picture option from the drop-down list.
   c. Click the down arrow below the Paste button in the Home tab of the Ribbon, and select the Embed Workbook option from the drop-down list.
   d. Click the Object button in the Insert tab of the Ribbon.
2. Which of the following is true with respect to creating a linked chart image in a PowerPoint slide?
   a. The image will always reflect any changes that are made in the Excel workbook.
   b. You will not be able to run PowerPoint in slide show mode unless the Excel workbook is open.
   c. You must activate the image and click the Refresh Data button in the Design tab of the Ribbon to ensure any changes made in the Excel workbook are reflected in the image pasted into the PowerPoint slide.
   d. You must have the Excel workbook open for the image to be refreshed in the PowerPoint slide.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Chapter Assignments and Tests

To assess your understanding of the material covered in the chapter, please complete the following assignments.

Chapter 4 Skills Review Parts A (You will also do Part B)

Fashion Industry Size Analysis (Comprehensive Review Part A)

Starter File: Chapter 4 CiP Exercise 1

Difficulty: Level 1 Easy

If you are contemplating a career in the fashion industry, you will likely be working with an apparel size analysis report. Understanding the most commonly purchased sizes is critical for any company in the fashion industry. For example, in the apparel manufacturing industry, you will have to know how many units to manufacture in each size for a particular garment. In addition, you will have to know the exact garment specifications for the sizes small, medium, large, and so on.

If you are pursuing a career on the retail side of the fashion industry, your job may be a little more complicated. You will have to know how many units of each size of a particular garment to ship to each store. There is nothing more devastating to a fashion company's sales than luring customers into a store with a great-looking garment and not having their sizes available.

The charts presented in this chapter can be valuable tools in analyzing size information for garments. This exercise uses the concept of the frequency distribution and frequency comparison to analyze demand by garment size for the knit tops department of Worldwide Apparel Manufacturing Company. The information displayed on these charts will be used to establish the production plan for manufacturing the garments for this department.

Begin this exercise by opening the file named Chapter 4 CiP Exercise 1.

1. Add the 3-line title in A1. Include the company name in the title, Unit Sales by Size in the Knit Tops Department.

The company wants to chart the percentage of knit top sales by size.

2. Highlight the range A4:A8 on the **Size Analysis** worksheet.
3. Hold down the CTRL key on your keyboard and highlight the range C4:C8.
4. Click the Column button in the Insert tab of the Ribbon. Select the Clustered Column format option from the drop-down list.
5. Move the column chart to the worksheet named TSCS Grading by clicking the Move Chart button in the Design tab of the Ribbon.
6. Resize the chart so the upper left corner is in A1 and the lower right corner is in U50. Click in the chart title and text. Type **Knit Tops Unit Sales by Size** into the formula bar

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

and hit Enter. If there is no chart title box present, then Add a Chart Element for the Title.

7. Format the chart title by selecting Subtle Effect - Blue, Accent 1 from the preset shape style formats in the Format tab of the Ribbon. Change the font style of the chart title to Arial and change the font size to 24 points.
8. Click any of the bars in the plot area of the chart. Click the down arrow on the Theme Styles button in the Format tab of the Ribbon. Select the Moderate Effect- Blue, Accent 1, from the drop-down palette. (Fifth row down, 2nd from left.)
9. From the Add Chart Element drop-down, select Data Labels. Select the Inside End option from the drop-down list.
10. Click any data label on the bars of the chart one time. Use the formatting commands in the Home tab of the Ribbon to change the font style to Arial, change the font size to 14 points, text color to white, and bold the font.
11. Use the formatting commands in the Home tab of the Ribbon to format the X and Y axis. Click anywhere on the axis to activate it. Then change the font style to Arial, change the font size to 14 points, and bold the font.
12. Click anywhere on the plot area of the chart to activate it. Click and drag down the top center sizing handle approximately one inch. There should be about one inch of space between the bottom of the chart title and the top of the plot area.
13. Click the Text Box button in the Insert tab of the Ribbon. Starting from the far upper left side of the chart area, approximately one-half inch below the top, click and drag a box that is approximately two and a half inches wide and one-half inch high.
14. Format the text box using the commands in the Home tab of the Ribbon. Change the font style to Arial, change the font size to 12 points, and select the bold and italics commands.
15. Type the following in the text box: **Based on 2025 Unit Sales**.
16. Click cell G4 on the **Size Analysis** worksheet.
17. Click the Column button in the Insert tab of the Ribbon and select the 3-D Clustered Column format from the drop-down list.
18. Move the chart so the upper left corner is in the center of cell G2.
19. Resize the chart so the left side is snapped to the left side of Column G, the right side is snapped to the right side of Column N, the top is snapped to the top of Row 2, and the bottom is snapped to the bottom of Row 18.

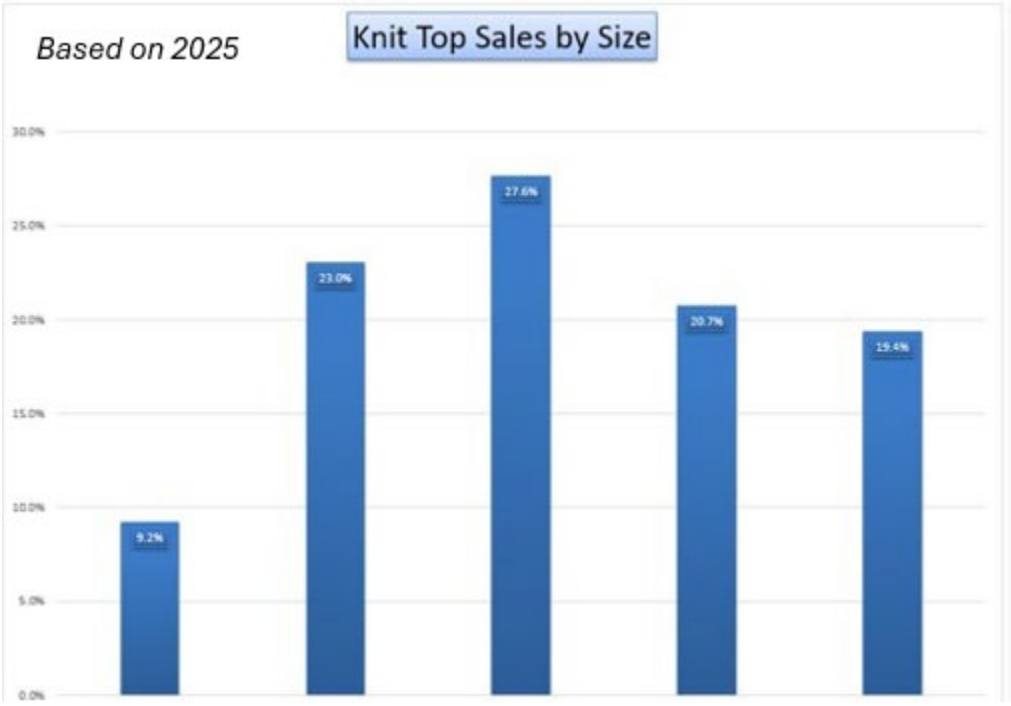
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

20. Click the Select Data button in the Design tab of the Ribbon.
21. Click the Add button on the Select Data Source dialog box.
22. Type **Knit Tops** in the Series name input box. Then press the TAB key on your keyboard, highlight the range C4:C8, and click the OK button on the Edit Series dialog box.
23. Click the Add button again on the Select Data Source dialog box.
24. Type the word **Company** in the Series name input box. Then press the TAB key on your keyboard, highlight the range E4:E8, and click the OK button on the Edit Series dialog box.
25. Click the Edit button on the right side of the Select Data Source dialog box.
26. Highlight the range A4:A8 and click the OK button on the Axis Labels dialog box. Then click the OK button on the Select Data Source dialog box.
27. From the Quick Layout button, select Layout 9 which will add your chart title, axis titles and legend.
28. Click on the title box. The title should state the following: **Size Comparison 2025 Unit Sales**. Change the font to Arial and the size of the title to, 14 points and select the Underline command in the Home tab of the Ribbon.
29. Delete the X axis title.
30. Click on the Y axis. The title should state: **Percent of Total Unit Sales**. Change the font size of the title to Arial 10 points in the Home tab of the Ribbon.
31. Click anywhere on the Y axis to activate it. Then click the Format Selection button in the Format tab of the Ribbon.
32. Click the Number option in the Format Axis dialog box. Click in the Decimal Places input box and change the value to zero. Then click the X button at the top of the Format Axis dialog box.
33. Use the formatting commands in the Home tab of the Ribbon to format the X and Y axis. Click anywhere on the axis to activate it. Then change the font to Arial and the size to 10 points and bold the font.
34. Click and drag the legend so the top border of the legend aligns with the top line of the chart plot area. Use the formatting commands in the Home tab of the Ribbon to apply bold and italics.
35. Click anywhere on the plot area to activate it. Then click the down arrow on the Shape Fill button in the Format tab of the Ribbon. Select the Blue, Accent 1, Lighter 60% option from the color palette.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

35. From the Format Selection box, select Walls. From the Theme Styles drop down select Subtle Effect, Blue Accent 1.
36. Click any of the bars representing the Knit Tops data series Then click the down arrow on the Shape Fill button in the Format tab of the Ribbon. Select the Intense Effect, Blue Accent 1 option from the theme palette.
37. Click any of the bars representing the Company data series Then click the down arrow on the Shape Fill button in the Design tab of the Ribbon. Select the Intense Effect, Red Accent 2 option from the theme palette.
38. Save the workbook by adding your name in front of the current workbook name(i.e., "*your name* Chapter 4 CiP Exercise 1").
39. Close the workbook and Excel.

Figure 4.64 Completed 2-D Column Chart CiP Exercise 1



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.65 Completed 3-D Column Chart CiP Exercise 1

Image title not updated to 2025 Sales

Chapter 4 Skills Review Part B

Fashion Retail Markdown Analysis (Comprehensive Review Part B)

Starter File: Chapter 4 CiP Exercise 1 (Continued from Comprehensive Review Part A)

Difficulty: Level 2 Moderate

The following exercise continues the fashion industry theme that was presented in part A of this exercise. In this exercise, we focus on the retail side of the fashion industry. Markdowns are a critical component for operating a successful fashion retail business. When an item is marked down, the price is reduced by a certain amount with the expectation that it will increase the number of units sold. This is also known as putting an item on sale. You have probably seen, and perhaps taken advantage of, these sales during a visit to your local mall. A surplus of inventory can present considerable losses for a fashion retailer.

Therefore, the timing and the amount of discount taken on an item is critical in managing the inventory for these companies. The increase in the number of units sold will depend on the size of the discount offered on a particular item. The scatter chart demonstrated in this chapter is a valuable tool in analyzing the rate at which unit sales increase when discounts are offered on an item. Begin this exercise by opening the file named Chapter 4 CiP Exercise 1 or continue with this file if you completed Comprehensive Review Part A.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

1. Click cell E2 on the **Markdown Analysis** worksheet.
2. Click the Scatter button on the Insert tab of the Ribbon. Select the Scatter with Smooth Lines and Markers format option.
3. Move the chart so the upper left corner is in the center of cell E2.
4. Click the Select Data button in the Design tab of the Ribbon. Then click the Add button on the Select Data Source dialog box.
5. Complete the inputs for the Edit Series dialog box as follows:

a. Series Name: Markdowns and Unit Sales

b. Series X Values: A3:A17

c. Series Y Values: C3:C17

6. Click the OK button on the Edit Series and Select Data Source dialog boxes.
7. Move the chart to the worksheet called MC Grading. Resize chart so it fits from A1:U50
8. From the Quick Layout button on the Chart Format ribbon, select Layout 1. Delete the legend.
9. Click anywhere on the Y axis to activate it. Click the Format Selection button in the Format tab of the Ribbon.
10. Change the scale of the Y axis so the minimum value is set to 100 units. Then click the X button at the top of the Format Axis dialog box.
11. Change the scale of the X axis so the maximum value is set to 70%.
12. Format the X and Y axes to an Arial font style, bold, and font size of 12 points.
13. Add an X axis title that reads **Discount Applied to Original Price**. Format the title with the Subtle Effect - Blue, Accent 1 preset shape style. Change the font style to Arial, bold, italics, and font size of 12 points.
14. Add a Y axis title that reads **Weekly Unit Sales**. Use the Rotated Title alignment. Format the title with the Subtle Effect - Blue, Accent 1 preset shape style. Change the font style to Arial, bold, italics, and font size of 12 points.
15. Create a chart title that reads: **Markdowns and Unit Sales 2025**. Format the chart title with the Subtle Effect - Blue, Accent 1 preset shape style. Change the font style to Arial and change the font size to 16 points.
16. Change the color of the plot area to white and the chart area to Blue, Accent 1, Lighter 80%.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Notice that when a discount is offered up to 20% off the original price, there is very little change in the number of units sold. This is typical in the fashion industry. If customers are not willing to pay full price for a particular style or color, it usually takes a substantial discount to convince them to buy.

17. Save the workbook.
18. Close the workbook and Excel.

Figure 4.66 Completed Scatter Chart CiP Exercise 1

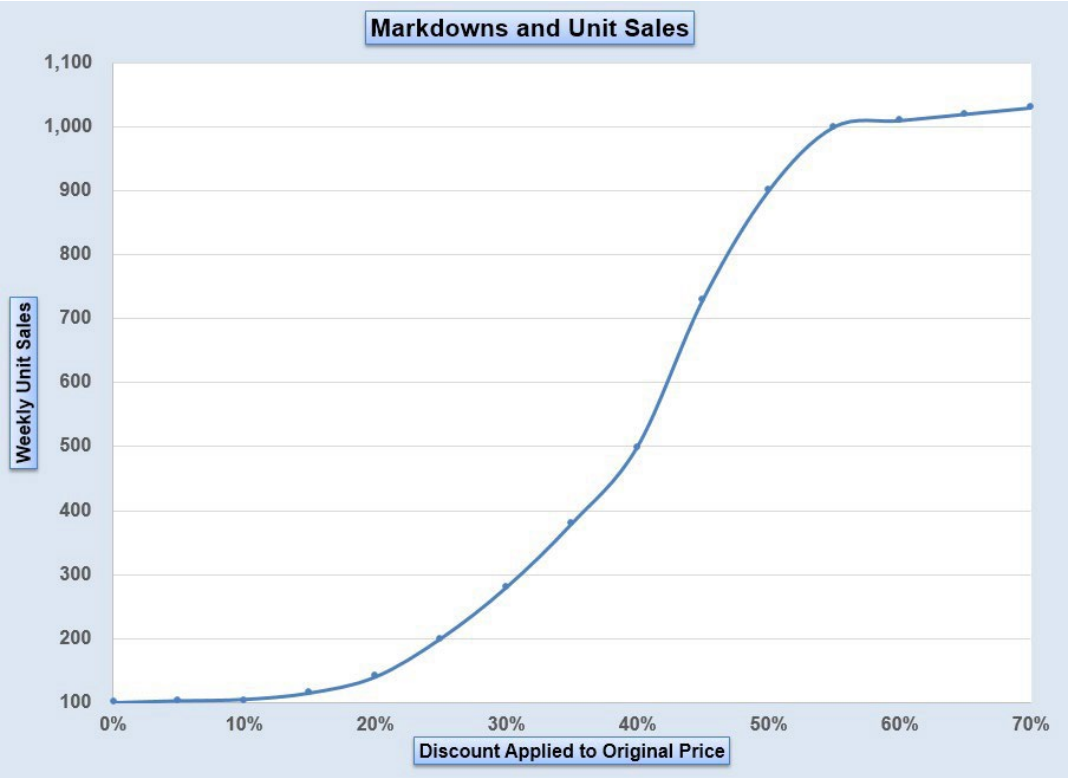


Image title not updated to 2025 Sales

Charts Case Study

Personal Spending and Savings Plan

Starter File: Chapter 4 CiP Exercise 2

Difficulty: Level 2 Moderate

Excel can be a valuable tool for constructing a personal budget. As mentioned in Chapter 2 "Mathematical Computations", developing a personal budget is an important exercise for establishing a path to financial security. One of the benefits of developing and maintaining a personal budget is that it allows you to maintain a healthy level of savings. Money that you save can be used to buy personal items. However, it can also be used to sustain your everyday expenses in the event you lose a job or source of income.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Without a reasonable level of savings, you may be forced to borrow money, which could come at very high interest expenses in the form of credit cards. Once you accumulate large debt balances at high interest rates, it can take years to pay off that debt, and the interest expense that you pay reduces savings for more important purposes such as college or retirement. What most people do not realize is that even what appears to be the most trivial overage in spending can rapidly eliminate any savings and quickly turn into debt. The purpose of this exercise is to use the charts in this chapter to evaluate a personal expense plan and to analyze the relationship that spending and net income have on your ability to save money. Begin this exercise by opening the file named Chapter 4 CiP Exercise 2.

1. Create a 3d -pie chart using the data in the **Expense Plan** worksheet. The chart should show the percent of total for the categories in the range A3:A10 based on the Annual Spend values in the range D3:D10. Use the Pie chart in 3-Dformat.
2. Move the pie chart to a to the EC Grading worksheet.
3. Remove the legend from the chart.
4. Edit the title of the chart to read **Personal Expenses 2025 - Total Expenses $27,000**. (Hint: copy and paste the above into your chart title. Exclude the period.) Format the chart title with an Arial font style, bold, italics, and font size of 20 points.
5. Add data labels to each section of the pie chart. Show only the category name and the percentage. Format the percentage to show one decimal place.
6. Format the data labels with an Arial font style, bold, and font size of 14 points. Notice that the mortgage and tax categories make up over 50% of total expenses.
7. Explode the chart by clicking on the pie, grabbing one wedge with your left mouse and drag out slightly.
8. On the Savings worksheet enter a formula into cell D4 . Your formula should add to the savings balance in cell D2 the result of subtracting the spending value in cell C4 from the net income value in cell B4.
9. Enter a formula into cell D5 on the **Savings** worksheet. Create a formula that adds the savings from D4 with the net income in B5 less the expenses in C5. Copy this formula and paste it into the range D6:D15 using the Paste Formulas command.
10. Create a line chart using the data in the **Savings** worksheet. The chart should show the months in the range A4:A15 along the X axis. The Y axis should show the dollar amounts

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

in the range B4:D15. There should be three data series displayed on the chart: Net Income, Spending, and Savings. (Hint: Include the column headers in your data selection.) Use the Line with Markers format option.

11. Move the chart so the upper left corner is in the center of cell F3.
12. Resize the chart so the left side is snapped to the left side of Column F, the right side is snapped to the right side of Column O, the top is snapped to the top of Row 3, and the bottom is snapped to the bottom of Row 18.
13. Add a chart title above the plot area that reads **Savings Analysis**. Format the title with the Subtle Effect - Red, Accent 2 preset shape style. Then change the font style to Arial, bold, and italics.
14. Add a title to the Y axis that reads **After Tax Dollars**. Use the Rotated Title alignment option.

    Format the title with the Subtle Effect - Red, Accent 2 preset shape style. Then, change the font style to Arial and change the font size to 12 points. Move the title if needed so it is on the far left of the chart area and centered along the Y axis.
15. Format the X and Y axes by changing the font style to Arial, making the font bold, and changing the font size to 12 points.
16. Change the scale of the Y axis so the minimum value is set to −500.
17. Move the legend to the right of the chart aligned with the $4,500 line of the plot area. Expand the width of the legend so it extends to the far-right side of the chart area. Then format the legend by changing the font style to Arial and making the font bold.
18. Change the color of the chart area to White, Background 1, Darker 15%, which is a shade of gray.
19. Add an annotation that begins approximately one inch above the Dec label on the X axis. The annotation should extend approximately one and one-quarter inches wide and approximately one- quarter inch in height. The annotation should read **Debt Incurred**. Format the annotation by changing the font style to Arial, bold, italics, and font size of 12 points.
20. Save the workbook by adding your name in front of the current workbook name (i.e., "*your name* Chapter 4 CiP Exercise 2").
21. Close the workbook and Excel.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 4.67Completed Pie Chart CiP Exercise 2

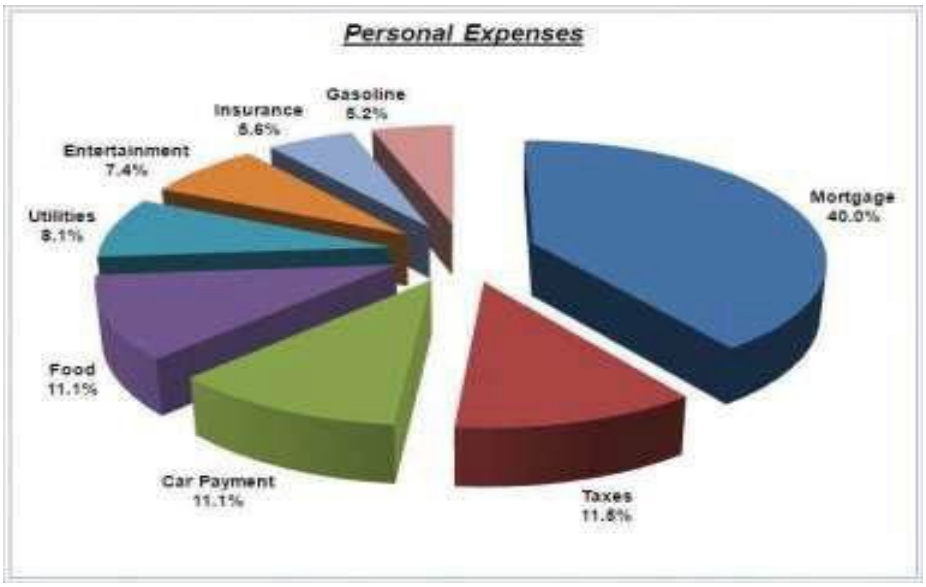


Figure 4.68Completed Line Chart CiP Exercise 2

Savings Analysis
Beginning Savings Balance $ 1,500
Month | Net Income | Spending | Savings
Jan $ 3,000 $ 3,000 $ 1,500
Feb $ 3,000 $ 2,000 $ 2,500
Mar $ 3,000 $ 4,000 $ 1,500
Apr $ 3,000 $ 3,000 $ 1,500
May $ 3,000 $ 3,150 $ 1,350
Jun $ 3,000 $ 3,300 $ 1,050
Jul $ 3,000 $ 3,250 $ 800
Aug $ 3,000 $ 2,700 $ 1,100
Sep $ 3,000 $ 3,100 $ 1,000
Oct $ 3,000 $ 3,350 $ 650
Nov $ 3,000 $ 3,450 $ 200
Dec $ 3,000 $ 3,700 $ (500)
Savings Analysis
After Tax Dollars
$4,500
$4,000
$3,500
$3,000
$2,500
$2,000
$1,500
$1,000
$500
$-
$(500)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Net Income
Spending
Savings
Debt Incurred

Integrity Check

Starter File: Chapter 4 IC Exercise 3

Difficulty: Level 3 Difficult

The purpose of this exercise is to analyze a worksheet to determine if there are any integrity flaws. Read the following scenario, then open the Excel workbook related to this exercise. You will find a worksheet in the workbook named **AnswerSheet**. This worksheet is to be used for any written responses required for this exercise.

Scenario

You are working as the director of investment research for a small wealth management firm. Your firm helps people make investment decisions and establish plans for key life events such as saving for college, retirement, and so on. An intern who is working for the

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

firm is evaluating the profit trends for two companies: Big Company and Goode Company. He sends you an Excel workbook and explains the following with respect to his analysis:

- I put a chart together to compare the earnings for the two companies. There is really nothing to look at. Big Company's profits are so much larger than those for the Goode Company. Based on this chart, I don't see how we would advise our clients to invest in the Goode Company. We should probably stick with the BigCompany.
- Just so you know, the profit numbers on the chart are in thousands. Otherwise, it is a pretty

straightforward column chart. I put the profits the companies earned for each quarter on the Y axis and the quarters are shown on the X axis.

Assignment

1. How many points of data is the analyst using on the chart? Does it make sense to use a column chart for this analysis? If not, what would be a better choice? Place your answer in the **AnswerSheet** worksheet.
2. Look at the profit values for the two companies. Does it make sense to compare these values? If not, explain why and what alternatives you could pursue. Place your answer in the **AnswerSheet** worksheet.
3. The analyst mentioned that the profit numbers are in terms of thousands. Would this be apparent by looking at the chart? If not, why? Place your answer in the **AnswerSheet** worksheet.
4. Looking at the X axis of the column chart, you will see that the quarters keep repeating 1 through 4 for each year in Column A. Can anything be done to show the year that each set of four quarters represents? Place your answer in the **AnswerSheet** worksheet.
5. Move the chart created by the analyst to a separate chart sheet and label the sheet tab Analyst's Chart. Make any necessary modifications to the Profit Analysis worksheet to create a chart that presents an appropriate comparison between the Big Company and the Goode Company. Create a new chart comparing the profits of the Big Company and the Goode Company. Pay careful attention to formatting details.
6. Do you agree with the analyst's conclusion that the firm should advise clients to invest in the Big Company over the Goode Company? Place your answer in the **AnswerSheet** worksheet.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Applying Excel Skills

Hotel Occupancy and Cleaning Expenses

Starter File: Chapter 4 AES Assignment 1

Difficulty: Level 3 Difficult

The purpose of this exercise is to analyze the activity and cost data for a hotel using a scatter chart. The data provided in the **Hotel Costs** worksheet can be used to establish a trendline on a scatter chart. The equation for the trendline can then be used to determine what the hotel may incur regarding cleaning costs at different levels of occupancy. This is an alternative to the High Low method presented in Chapter 2 "Mathematical Computations". Your assignment is to create the scatter chart and construct a formula that can be used for planning cleaning costs at different levels of occupancy based on the following requirements:

1. Columns B and C in the **Hotel Costs** worksheet contain occupancy and cleaning cost data for 12 months. Create a scatter chart that shows just the plot points (Scatter with only Markers) for the occupancy and cleaning costs for each month on this worksheet. The chart should be embedded in the **Hotel Costs** worksheet and should include the appropriate formatting techniques covered in this chapter.
2. Adjust the scale of the X and Y axes so the minimum value is 2000.
3. Add a linear trendline to the chart and show the equation.
4. Use the trendline equation to enter a formula in cell C19 that calculates the estimated cleaning costs based on the occupancy level that is typed into cell C18.

Quality Control Analysis

Starter File: Chapter 4 AES Assignment 2

Difficulty: Level 3 Difficult

The purpose of this exercise is to analyze how cost changes in the operations of a quality control department impact the overall cost of quality for a manufacturing company. The Quality Control worksheet contains two years of cost data for four components of a quality control department: prevention, inspection, internal failure, and external failure. You will see that total quality costs decreased from year 1 to year 2. Create a chart that you believe is most appropriate to present the change in costs from one year to the next. The requirements are as follows:

1. The chart should show which components are increasing or decreasing from year 1 to year 2. In addition, the dollar value for each component should appear on the chart for each year.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

2. The total quality control costs for each year should be specified on the chart.
3. The chart should appear in a separate chart sheet.
4. You should include appropriate formatting techniques covered in this chapter.

Skills Chapter Test

Starter File: Chapter 4 Skills Test

Difficulty: Level 2 Moderate

Answer the following questions by executing the skills on the starter file required for this test. Answer each question in the order in which it appears. If you do not know the answer, skip to the next question. Open the starter file listed above before you begin this test.

1. Create a pie chart using the data in the **Market Share** worksheet. The pie chart should show the percent of total for only the year 2025. Use the Exploded Pie in 3-D format.
2. Move the chart so the upper left corner is in the center of cell E2.
3. Resize the chart so the left side is locked to the left side of Column E, the right side is locked to the right side of Column M, the top is locked to the top of Row 2, and the bottom is locked to the bottom of Row 17.
4. Remove the legend.
5. Change the chart title to the following: **Market Share for the Year 2025**.
6. Add the Category Name and Percentage data labels to the outside end of each section of the pie chart.
7. Bold the data labels and change the font style to Arial.
8. Create a 100% stacked column chart using the data in the **Market Share** worksheet. The stacked column chart should show the percentages 0% to 100% along the Y axis. The X axis should show stacks for the year 2015 and 2025. There should only be two stacks, or columns, in the plot area showing the percent of total for each company.
9. Move the 100% stacked column chart to a separate chart sheet. The tab name for the chart sheet should read **Market Share Chart**.
10. Remove the legend from the stacked column chart and add a data table with legend keys below the X axis.
11. Add a title above the chart that reads **10-Year Change in Market Share**.
12. Format the chart title using the Subtle Effect - Red, Accent 2 preset shape style. Change the font style to Arial and the font size to 20 points.
13. Add a Y axis title that reads **Market Share**. Use the Rotated Title alignment.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

14. Format the Y axis title using the Subtle Effect - Red, Accent 2 preset shape style. Change the font style to Arial and the font size to 16points.
15. Format the X and Y axes by changing the font style to Arial, making the font bold, and changing the font size to 14 points.
16. Change the fill color of the chart area to Tan, Background 2, Darker 10%.
17. Add series lines that connect each section of the two stacks in the plot area.
18. Create a column chart showing just the Company Sales in the **Sales Data** worksheet. The chart should show the Company Sales in the range B3:B13 along the Y axis. The years in the range A3:A13 should appear on the X axis. Use the basic 2-D Clustered Column format. The series name should be **Gross Sales**.
19. Move the column chart to a separate chart sheet. The tab name for the chart sheet should read **Company Sales Chart**.
20. Remove the legend on the column chart. Then format the X and Y axes by changing the font style to Arial, making the font bold, and changing the font size to 16 points.
21. Reduce the height of the plot area by approximately one inch. There should be about one inch of space between the bottom of the chart title and the top of the plot area.
22. Add an annotation above the Y axis that reads **Sales in Millions**. Format the annotation with an Arial font style, bold font, italics font, and font size of 14 points.
23. Change the color of the bars in the plot area to dark red.
24. Create a line chart comparing the change in sales for the company and overall industry in the **Sales Data** worksheet. Construct the chart as follows:
    - The Y axis should show the growth percentages for the company in the range C3:C13 and the growth percentages for the industry in the rangeE3:E13.
    - The series name for the company growth percentages should be **Company**.
    - The series name for the industry growth percentages should be **Industry**.
    - The years in the range A3:A13 should appear on the X axis.
    - Use the Line with Markers format.
25. Move the chart so the upper left corner is in the center of cellG2.
26. Resize the chart so the left side is locked to the left side of Column G, the right side is locked to the right side of Column P, the top is locked to the top of Row 2, and the bottom is locked to the bottom of Row 18.
27. Adjust the scale of the Y axis so the maximum value is set to.20.
28. Format the values on the Y axis so there are zero decimal places.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

29. Save the workbook by adding your name in front of the current workbook name(i.e., "*your name* Chapter 4 Skills Test").
30. Close the workbook and Excel.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Chapter 5

Tables and PivotTables

Until now in this text we have dealt with small amounts of data. However, the more common situation in businesses today is having very large data sets to manipulate and make sense of. For example, large amounts of data can come from Access databases, data mining on the web, exporting from an accounting program, or many other places. The data can be thousands upon thousands of rows of raw data. How can we efficiently manipulate that kind of overwhelming data?

In this chapter, we will explore the built-in tools in Excel that allow us to easily manipulate large data sets. Excel will easily condense, sort, filter, and subtotal data. Using PivotTables and PivotCharts we will see the power of Excel to condense raw data into easily manipulated reports.

5.1 Creating an Excel Table

LEARNING OBJECTIVES
1. Create an Excel Table.
2. Rename the table.
3. Change the table style.
4. Add records to the table.
5. Delete records from the table.
6. Add a total row and change the results.
7. Add columns to the table.
8. Use table references in functions and formulas.

Creating a Table

Georgia works in the accounting department for Great Education College. She is given the task of condensing the data around vehicles owned by the college. She must condense the information into easily understandable reports to be provided to the college board's finance committee.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Follow-along file: Excel Objective 5.00.

Georgia examines the data in the College Vehicles worksheet. She notes that each has an Asset number, the year vehicle was made, the make and style of the vehicle, which department has control of the vehicle, its purchase price and estimated annual maintenance cost. She will use this data to create her various reports.

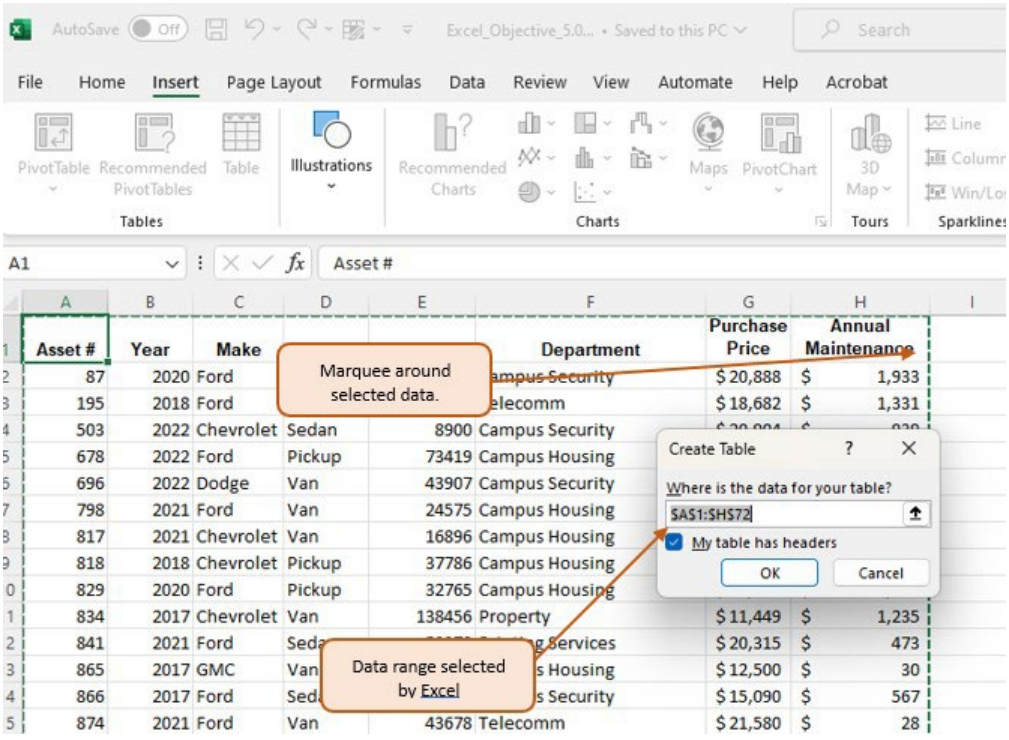
A few things to know about data in tables before we begin:

- Data must be in contiguous cells – no breaks in rows or columns.
- Headers must be next to the first row of data – no break in rows between headers and the start of your data.

We will create an Excel table to manipulate her data. The steps we will use to do that are:

1. Click on any cell within the list of data.
2. From the Insert ribbon, select Table. Excel will automatically determine the absolute range of cells that will be placed in your table. See Figure 5.01

Figure 5.1 Excel's Selection of Data



Asset #	Year	Make			Department	Purchase Price	Annual Maintenance
87	2020	Ford			Campus Security	$ 20,888	$ 1,933
195	2018	Ford			Telecomm	$ 18,682	$ 1,331
503	2022	Chevrolet	Sedan	8900	Campus Security		
678	2022	Ford	Pickup	73419	Campus Housing		
696	2022	Dodge	Van	43907	Campus Security		
798	2021	Ford	Van	24575	Campus Housing		
817	2021	Chevrolet	Van	16896	Campus Housing		
818	2018	Chevrolet	Pickup	37786	Campus Housing		
829	2020	Ford	Pickup	32765	Campus Housing		
834	2017	Chevrolet	Van	138456	Property	$ 11,449	$ 1,235
841	2021	Ford	Seda		g Services	$ 20,315	$ 473
865	2017	GMC	Van		s Housing	$ 12,500	$ 30
866	2017	Ford	Sed		s Security	$ 15,090	$ 567
874	2021	Ford	Van	43678	Telecomm	$ 21,580	$ 28

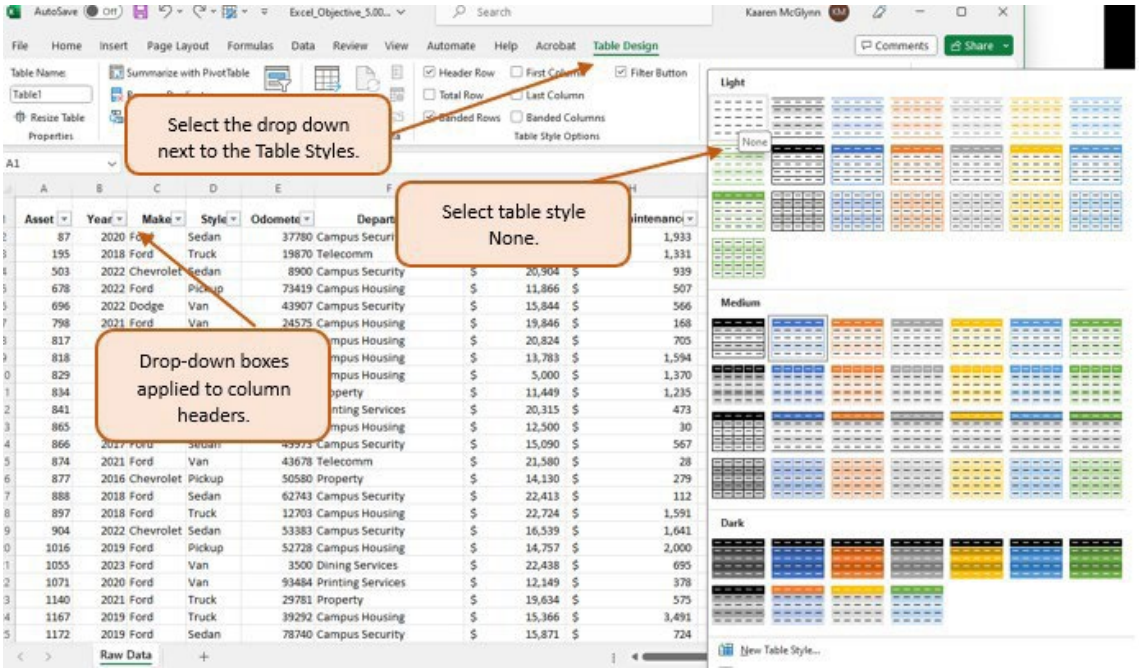
1. From the Create Table dialog box check to make sure it includes all of the data table. You will see a marquee around your table and the range selected will be in the dialog box. You can use the dialog box to select the correct data if the range is not correct.
2. Click Ok

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Excel will automatically apply a color style with banded rows. We will eliminate the banded rows because it only adds visual clutter to the data. Remember our data needs to tell a story without clutter. The banded row format will lose the ability to maintain the banded row colors when the table is converted back to a range. *Note: we will cover converting back to a range later.*

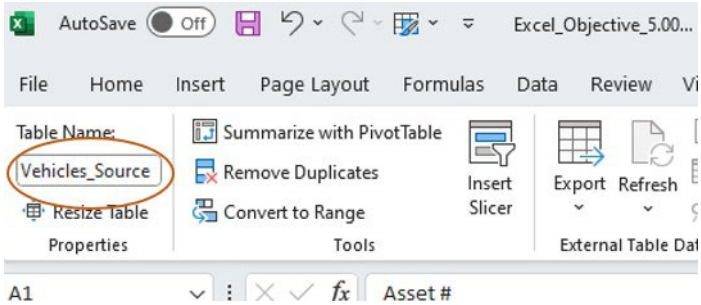
3. In the Table styles section of the Table Tools Design ribbon, use the drop-down in the styles and select None. (Top row, first column) See Figure 5.2. The None style will revert the appearance of your table back to a normal spreadsheet, except that now you will have drop-down arrows next to each of the column headers.

Figure 5.2 Selecting the None Style for the Excel Table.



4. Rename the table to Vehicles_Source by clicking in the Table Name Box on the Table Tools ribbon. *Note: the same rules that you learned for naming cells and ranges applies to naming tables.*

Figure 5.3: Renaming the Excel Table.



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Integrity Check- Creating a table when your worksheet has a title directly above the column headers
If the worksheet has a title, i.e. a company name, purpose of the worksheet, or any data etc. in the row directly above the data range you will be converting to a table, you must insert a blank row between the data above the table data and the column headers for the data table. Excel will not be able to determine the correct data range that will be converted to a table they are adjacent to each other.

Adding Records

Maintaining data in an Excel tables means that you will most likely be adding or deleting records from the table. The simplest way to add a record to an Excel table is to add it at the first blank row at the bottom of the table.

The school recently purchased another vehicle for the maintenance department. The record for the vehicle needs to be added to the Vehicle_Source table. The data for the new vehicle is:

- Asset # 2625
- Year 2020
- Make: Dodge
- Style: Pickup
- Odometer: 125
- Department Maintenance
- Purchase price: $44,250
- Annual Maintenance: $2,232

1. From anywhere in the worksheet hold the Ctrl key down and click the End key.
2. Click the Home key to move you to column A.
3. Hit Enter once to move you to the first blank row.
4. Enter the data above. Use the tab key to move you across the cells as you enter the data. *Note: as you enter the new data, the table will continue the formatting from the data in the column above the new entry.*

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Skill Refresher- Adding New Records
1. Click in the row below the last row of the Excel Table 2. Type the values for the new record, pressing the Tab key to move from field to field. 3. Press the Tab key to create a new record. OR Press the enter key if this is your last record.

Finding and Editing Records

You need to update the records for the 2021 Chevrolet van, asset number 1196, and the 2017 Ford van, asset number 1678. They have been reassigned from Campus Housing to the Athletics department. You'll use the Find command to locate the records. Then, you will edit the record to change the assigned departments to Athletics.

1. Press the Ctrl+Home keys to move to the top of the worksheet, and then click cell A2 to make it the active cell. You will search on the asset number because it is a distinguishing number in the table.
2. In the Editing group on the Home tab, click the Find & Select button, and then click Find. The Find and Replace dialog box opens.
3. Type 1140 into the Find what: dialog box. Then click Find Next. Leave the Find and Replace dialog box open while you edit the first record.
4. Click F26 and change the department to Athletics. *Note: As you type the A, the Athletics department will appear in the auto complete. Hit enter to accept the department.*
5. In the Find and Replace dialog box, delete the 1196 asset number and enter the next record number that must be updated, 1678. Click Find Next. Then close the dialog box.
6. Change the department to Athletics.

Skill Refresher – Finding and Editing Records
1. Make a cell in the column you want to search active. 2. In the Editing group of the Home tab, click Find and Replace. 3. Select Find. 4. Enter the information you want to find. 5. Click Find Next.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

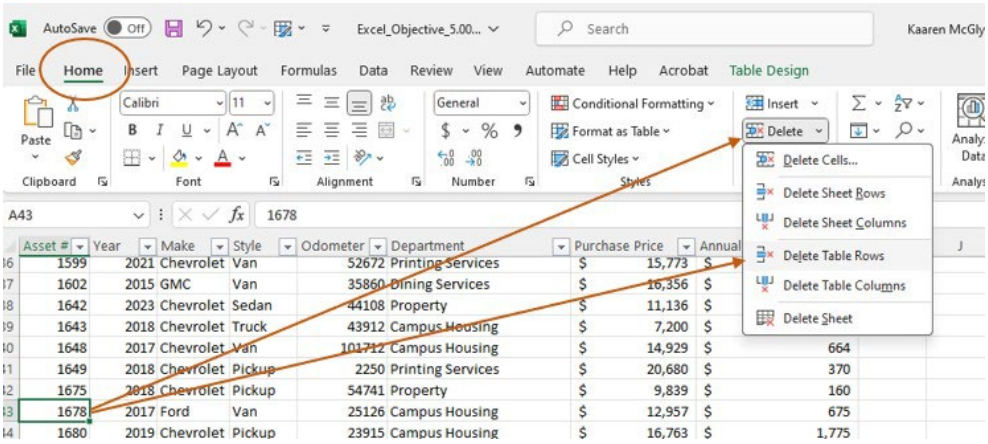
Deleting Records

The last update required is to delete a record for a sold vehicle. Asset number 1733, a 2015 Ford pickup was sold and needs to be removed from the asset list.

The steps you will use to delete the record are:

1. Press the Ctrl+Home keys to move to the top of the worksheet, and then click cell A2 to make it the active cell. You will search on the asset number because it is a distinguishing number in the table.
2. In the Editing group on the Home tab, click the Find & Select button, and then click Find. The Find and Replace dialog box opens.
3. Type 1678 into the Find what: dialog box. Then click Find Next. Close the Find and Replace Dialog box.
4. In the Cells group of the Home tab, click the Delete button and select Delete Table Rows from the drop down. *Note: If a different record was deleted, the active cell was not in the record for the Asset 1678. Click the Undo button and select the correct record.*

Figure 5.4: Deleting a Table Row.



Skill Refresher – Deleting Records

1. Find the record to be deleted.
2. In the Cells group of the home tab, click the Delete button and select Delete Table Rows from the drop-down.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Adding a Total Row

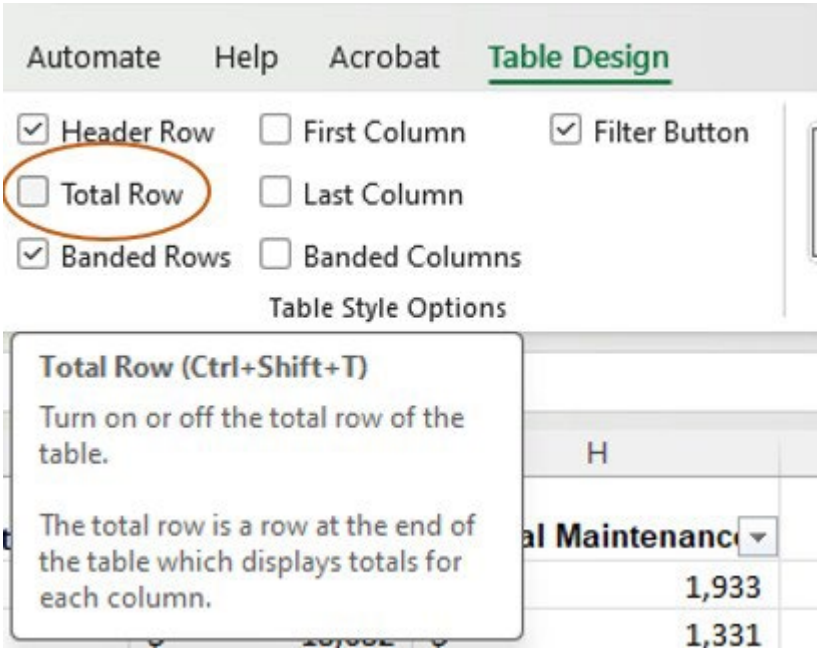
Follow-along file: Continue with Excel Objective 5.00. (Use file Excel Objective 5.01 if starting here.)

Georgia would like to see a count of how many vehicles the college owns. She wants to have the count be dynamically linked to the table contents.

The steps we will use to create a total row, and then change it to a count are:

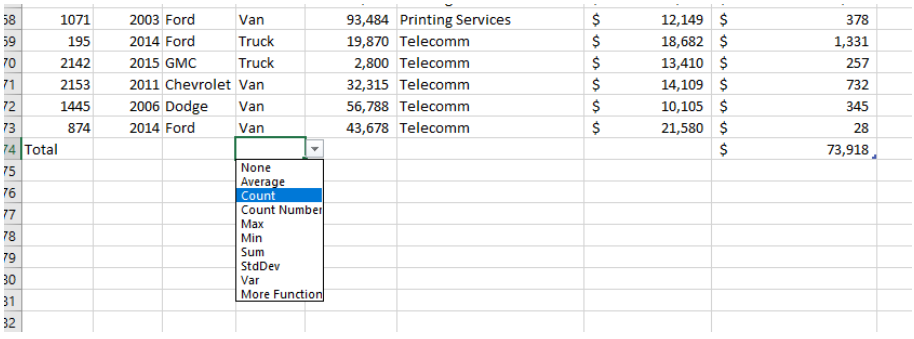
1. From the Table Style Options on the Table Tools Deign tab, check the box for TotalRow. *Note: you can uncheck the box to turn off the total row.*

Figure 5.5 Adding a Table Row



2. Excel will drop you down to the newly created total row. It will automatically put in a total for Annual Maintenance. We will accept that for now. Click on the total row for the Style. From the drop-down select count.

Figure 5.6: Adding the Count


1071 2003 Ford Van 93,484 Printing Services $ 12,149 $ 378
195 2014 Ford Truck 19,870 Telecomm $ 18,682 $ 1,331
2142 2015 GMC Truck 2,800 Telecomm $ 13,410 $ 257
2153 2011 Chevrolet Van 32,315 Telecomm $ 14,109 $ 732
1445 2006 Dodge Van 56,788 Telecomm $ 10,105 $ 345
874 2014 Ford Van 43,678 Telecomm $ 21,580 $ 28
Total
$ 73,918
None
Average
Count
Count Numbers
Max
Min
Sum
StdDev
Var
More Functions

3. Delete the word Total from the A column and type Total number of vehicles. (Don't worry about overlapping cell walls.)
4. In column g: type Total maintenance.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Remember: Your worksheet must tell a story all by itself! Take the time to tell the reader what the cells mean.

Adding a New Column

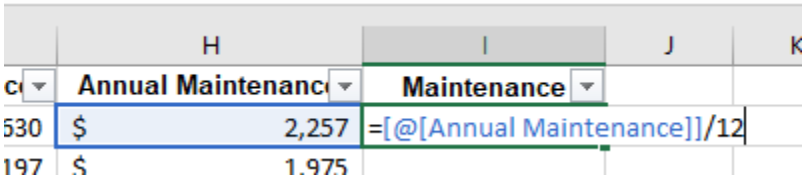
Follow-along file: Continue with Excel Objective 5.00. (Use file Excel Objective 5.02 if starting here.)

Georgia would like to see the monthly maintenance cost for each vehicle. She has asked you to add a column next to the Annual Maintenance column.

A unique feature of having your data in a table, versus just a range of data, is the ability to add a column, have the formatting applied, and the formulas added in the top row of the data will automatically copy down the worksheet.

We will add a new column by:

1. Click in cell I1. Type: Monthly Maintenance and hit Enter. The bold and center formatting will automatically be applied to the column header and a drop-down box will appear next to the column header.
2. Resize column I to fit the new header.
3. In I2 enter a formula to divide the Annual Maintenance by 12. Type = and click on cell H2. Notice that when you click on H2 you see something new in your formula. Instead of H2 you now see = [@[Annual Maintenance]]. This only occurs in a table. It will allow the formula to be copied down the range of cells in the table automatically. Type /12 after clicking on cell H2.



4. Hit enter to complete the formula.
5. Format the column by clicking on the column header to select it, then click on the lower border of the cell. This will highlight the column data. On the home ribbon select the accounting format.

Skill Refresher – Adding a New Column

1. Activate the top cell in the column directly next to your last column of data. If you have inserted a column, activate the top cell in the column.
2. Type the column header and hit enter.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

5.2 Sorting and Filtering Data

LEARNING OBJECTIVES
1. Sort data by one column. 2. Perform a multi-level sort involving data in different columns. 3. Filter data using column headers. 4. Filter data using a custom filter. 5. Create custom lists.

Sorting One Column

Follow-along file: Continue with Excel Objective 5.00. (Use file Excel Objective 5.03 if starting here.)

Integrity Check - Sorting and Filtering Data Without a Table
Sorting and filtering data **does not require** your data be in a table. Any range of contiguous data can be filtered by clicking on the Sort button from the Data tab. When selected, the same column header drop-down boxes will appear in your data range.

The records in the Asset record table appear in the order in which they were entered. There will be times when you are working on a data table, or creating reports, that you will want to see records sorted in a different order. For example, you may want to sort records by department, by make of car, or by odometer reading.

Data can be sorted in:

- Ascending order: lowest to highest, dates oldest to newest, or A to Z.
- Descending order: highest to lowest, dates newest to oldest, or Z to A.

Data can be quickly sorted by using the drop-down arrows to the right of each of the column headers. When you click on the arrow you will see the sort functions A to Z, or Z to A. *Note: you cannot use the sort for more than one column. If you want to sort by multiple columns, you must use the Sort button from the Data ribbon tab.*

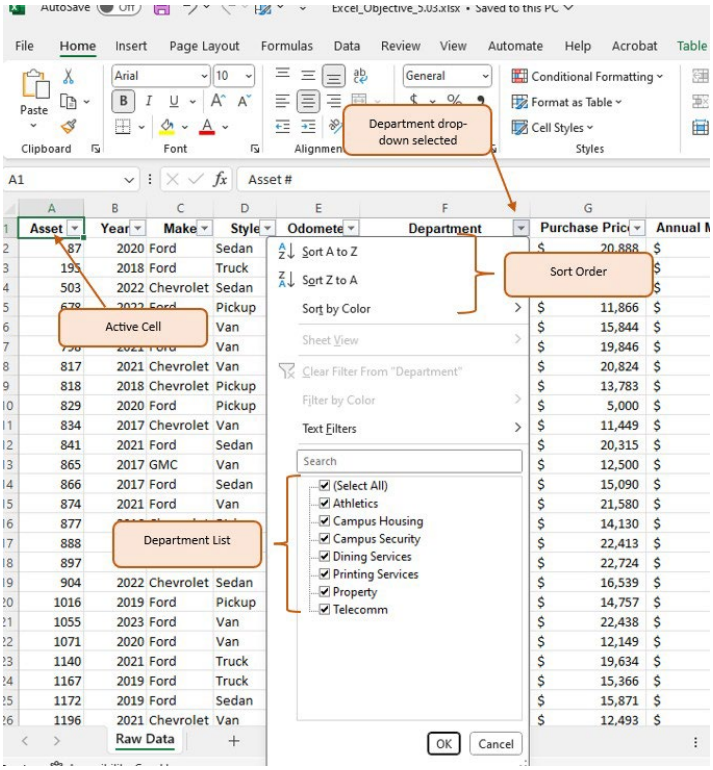
Georgia wants to see the table sorted by department to see how many vehicles are in each department. The steps to accomplish this are:

1. We want to maintain the integrity of our raw data, so we will copy the Raw Data worksheet and make our changes in the new worksheet. While holding the Ctrl key down, left click the worksheet tab and drag to the right. You will see a little image ofa piece of paper with a +. Drop the worksheet to the right of the original worksheet. The new worksheet will have the name Raw Data (2)

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

2. Rename the new worksheet College Vehicles by double clicking on the worksheet tab, eliminating the title there and entering the new title.
3. Click on the drop-down next to the Department column header. See Figure 5.4
4. Select the A to Z sort. Data is sorted with Athletics first, ending with Telecom.

Figure 5.5: Table Drop-Down Sort Feature.



Notice that the active cell in Figure 5.5 is A1. However, the drop-down selected was for the Department as indicated by the department names at the bottom of the list.

Multi-Column Sort

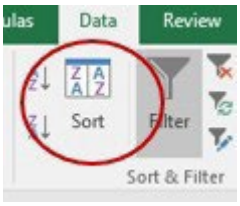
Using the drop-down in a table column makes a one series sort very quick and easy. However, trying to sort by multiple columns does not work using this method. As soon as you click on another column and perform a new sort, the original sort you created in the first column is overwritten by the new sort applied. You were briefly introduced to the Sort dialog box in Chapter1 for a single column sort. In this section, we will be dealing with performing a multi-column sort using the Sort dialog box.

The first thing that must be decided when performing a multi-column sort is what will be the primary sort, secondary, and so on.

Georgia, after looking at the sort, decides that a better view would be to sort by Department, then by Style, by Make, and finally by year purchased with the latest models first. To perform this multi-column sort, we will perform the following steps:

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

1. Have an active cell anywhere within your table or range.
2. From the Sort & Filter section of the Data ribbon, select Sort.



3. The sort dialog box will appear.
4. The first dialog box in the Sort is the Column. Whichever column contains your active cell will be the default Sort by in the column. The drop-down next to the column will have all of the column headings. Remember that Georgia wants to sort by department first. From the drop down select Department. *Note: My data has headers at the top right of the dialog box must be checked or Excel will treat your headers as part of the table data.*
5. In the Sort On field, select what cell contents the sort will focus on. The choices in the list are:
   - Values – this is the default. Whatever value is in the cell will be used for the sort.
   - Cell color – if cells have a conditional formatting, or highlighting, that fills a cell with color, it can be used in the sort. When selecting this option, a color selection box will

     be added to the Add level row. A second new selection box will appear that asks if the cell color should be on top of the other items in the column, or at the bottom.
   - Font color – – if contents of cells have a font color other than black, it can be used in the sort. When selecting this option, a color selection box will be added to the Add level row. This choice will also get the second box that asks where the cells containing color should be placed in the sort order.
   - Icons – Since Excel 2016 the placement of icons in a cell is allowed. This concept is not covered in this book, but if placed in a cell can be used as a sort.
6. The last field in the Sort is the Order field. You can sort in Ascending, Descending, or by a Custom List. (See Creating a Custom List in Section 5.2 Sorting and Filtering.) The default sort for text is A to Z. We will accept the default.
7. Click on Add level at the top right of the Sort dialog box. A new level will be added to the sort dialog box. In the dialog box for the Then by, select Style from the drop-down list. *Note: you can change a level by re-selecting from the drop-down. You can also delete a level by clicking on the row and clicking on Delete Level.*
8. Add another level for the Make.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

9. Add a final level for the year purchased. Change the Order for the Year to Largest to Smallest, so the newest vehicles are displayed first.
10. Click OK.

Figure 5.5: Creating a Multi-Level Sort in the Sort Dialog Box.

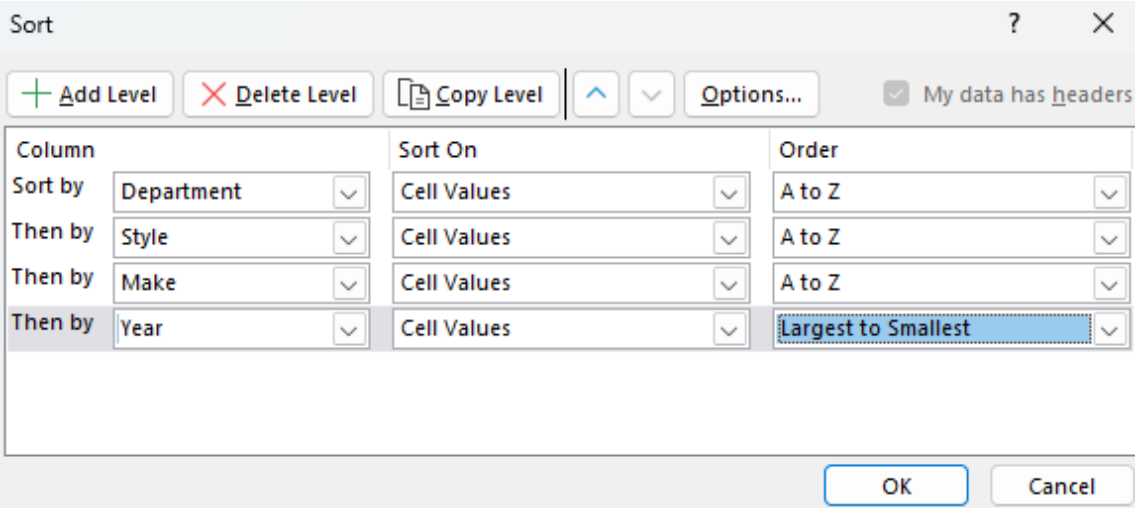
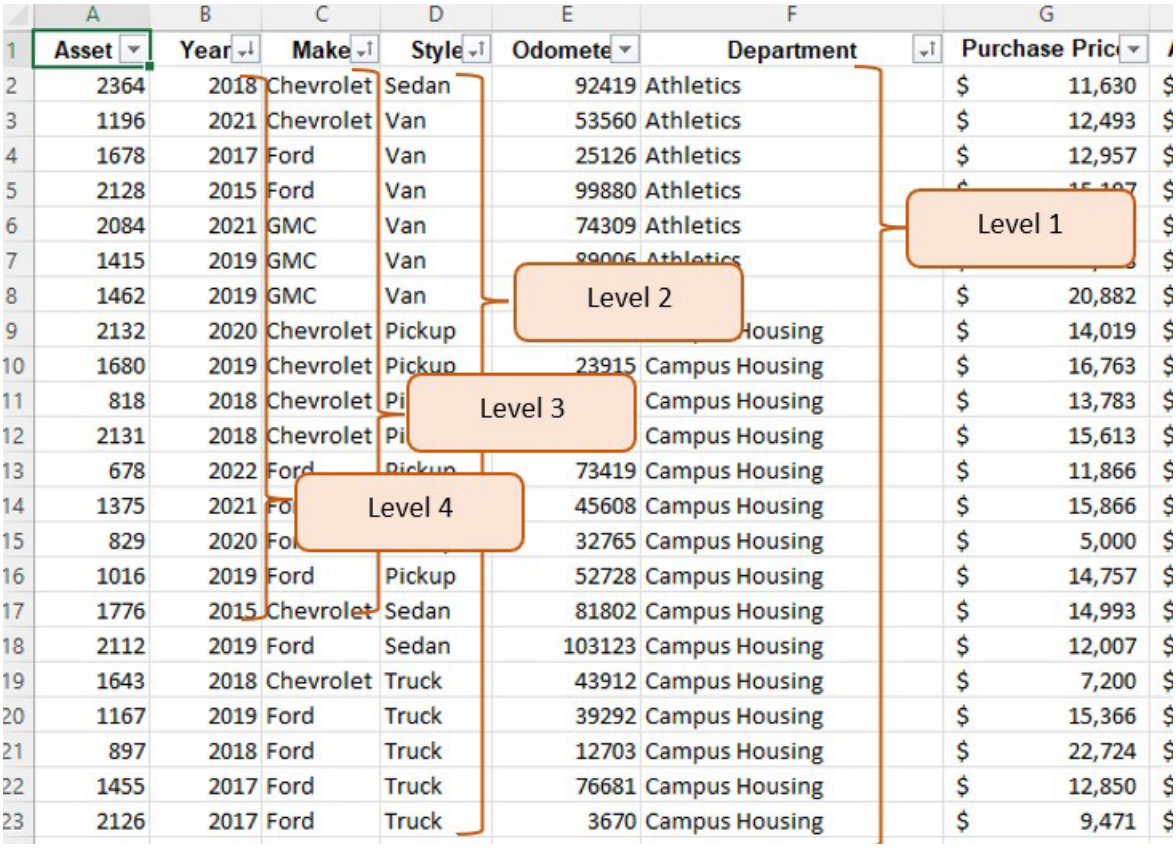
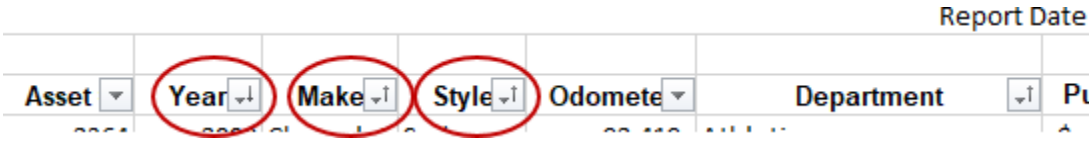


Figure 5.6: Sort Results.


Asset
Year
Make
Style
Odomete
Department
Purchase Pric
2364 2018 Chevrolet Sedan 92419 Athletics $ 11,630
1196 2021 Chevrolet Van 53560 Athletics $ 12,493
1678 2017 Ford Van 25126 Athletics $ 12,957
2128 2015 Ford Van 99880 Athletics
2084 2021 GMC Van 74309 Athletics
1415 2019 GMC Van
1462 2019 GMC Van $ 20,882
2132 2020 Chevrolet Pickup $ 14,019
1680 2019 Chevrolet Pickup 23915 Campus Housing $ 16,763
818 2018 Chevrolet Pi Campus Housing $ 13,783
2131 2018 Chevrolet Pi Campus Housing $ 15,613
678 2022 Ford 73419 Campus Housing $ 11,866
1375 2021 Fo 45608 Campus Housing $ 15,866
829 2020 Fo 32765 Campus Housing $ 5,000
1016 2019 Ford Pickup 52728 Campus Housing $ 14,757
1776 2015 Chevrolet Sedan 81802 Campus Housing $ 14,993
2112 2019 Ford Sedan 103123 Campus Housing $ 12,007
1643 2018 Chevrolet Truck 43912 Campus Housing $ 7,200
1167 2019 Ford Truck 39292 Campus Housing $ 15,366
897 2018 Ford Truck 12703 Campus Housing $ 22,724
1455 2017 Ford Truck 76681 Campus Housing $ 12,850
2126 2017 Ford Truck 3670 Campus Housing $ 9,471
Level 1
Level 2
Level 3
Level 4

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Note that after a sort is applied you will see arrows in the filter buttons next to the column headers indicating the column has been sorted and in which order (up or down) the sort was performed.



Skill Refresher – Multi-Level Sort

1. Click any cell in a table or range.
2. In the Sort & Filter dialog box on the Data tab, click the Sort button.
3. Click the Sort by arrow, select the column heading for the primary sort field.
4. Change the Sort On if necessary.
5. Select the Order of sort. Ascending, Descending, or Custom.
6. To sort by additional columns, click the Add Level button.
7. Click the OK button.

Sort Using a Custom List

Follow-along file: Continue with Excel Objective 5.00. (Use file Excel Objective 5.04 if starting here.)

There may be times when entering repetitive entries like days of the week, or sorting alphabetically or numerically in descending or ascending order doesn't give you the results you want to see. An example of this that we use often is sorting by the days of the week, or by months in the year. If we sorted those alphabetically we would come up with the jumbled orders you see in Table 5.1.

Table 5.1 Sorting Days and Months Alphabetically

Friday	April
Monday	August
Saturday	December
Sunday	February
Thursday	January
Tuesday	July
Wednesday	June
	March
	May
	November
	October
	September

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

There may also be times where you would sort by a specific part number order, or name. In cases like these, you need to sort using a custom list. There are several custom lists already established in Excel. They include the days of the week and the months in the year. You saw the custom lists in action when we filled the months down a column using the auto fill feature. The auto fill feature will also draw on any custom lists established in Excel. You may even want to edit a custom list that is already set up. For instance, if you only want to fill Monday – Friday as the days of the week, you can edit the days of the week list to eliminate Saturday and Sunday from the list. *Note: custom lists apply in all your workbooks. If you edit the days of the week list, it will be available in all your workbooks.*

Georgia wants to see the departments sorted in the following order:

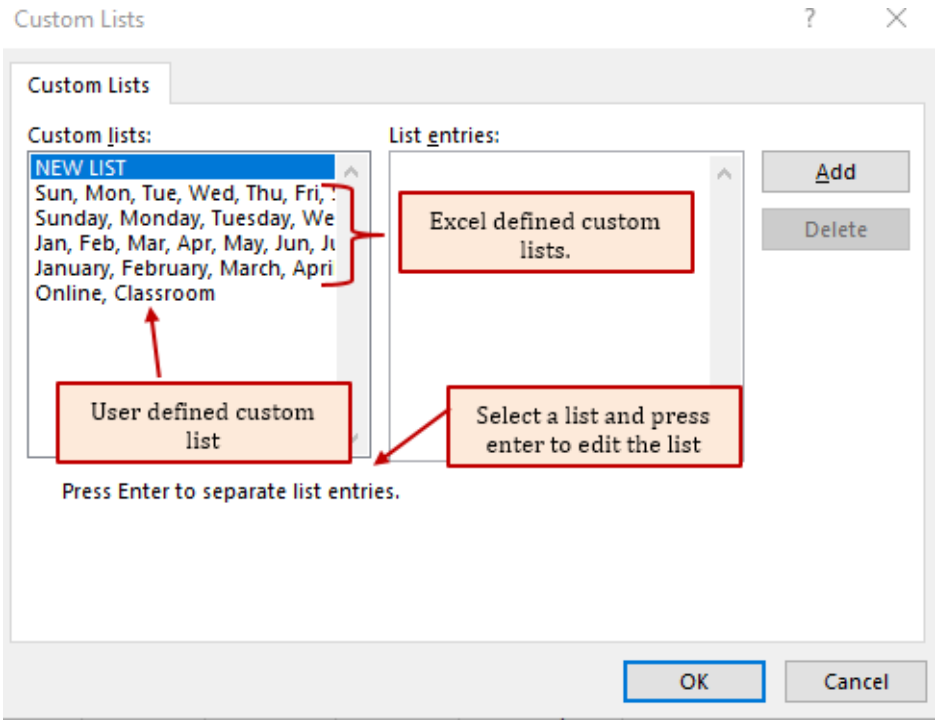
- Athletics
- Campus Housing
- Campus Security
- Printing Services
- Dining Services
- Telecom
- Maintenance

We will look at the custom lists already set up and set up a custom list for sorting the departments in an order different than alphabetically.

1. From the Sort & Filter section of the Data tab, click on the Sort button. The sort you established in the last section will be displayed.
2. In the Department row, click on the drop down next to the Order box.
3. Select Custom List. The Custom Lists dialog box will be activated.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 5.7: Custom Lists Dialog Box.



4. The NEW LIST option is automatically highlighted. Press Enter to create a new list or click in the List Entries box.
5. Type the departments in the order that Georgia gave you, or you can copy the listand paste if from another source if available.
6. When finished, click OK. *Note: Pressing enter will only move you down to a new row in your list.* Your custom list now shows in the Order box.

Excel for Mac – Creating a Custom List
• Click on Excel (at top of application) • Click on Preferences • Custom List

7. Re-sort the list by clicking OK. Your table is now sorted according to your custom list in the order Georgia wanted.

Skill Refresher – Creating a Custom List
1. Select a range of data, (can only be one cell containing data.) 2. Click the Sort button in the Sort & Filter section of the Data tab. 3. Select New list, or an established list if editing the list. 4. Generate the list in the List Entries box. 5. Click OK when finished.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Before we wrap up the Sort section, let's put a good title on our worksheet that describes what we have done to the worksheet. Remember that each worksheet must tell a story to the reader. To describe our story for this worksheet, we will describe the sort we did in the worksheet and what data the worksheet represents.

1. Merge and center cells A1:J1.
2. Click in the grey area of row 1, when you see the black arrow pointing right, hold your left mouse button down and drag down to row 2. Both rows 1 and 2 should be selected.
3. Using keyboard commands, hold down the Ctrl key and click the + key on your ten-key keypad if you have one. If you don't have one then hold down the Ctrl key, the shift key, and the + keys. This will add two rows at the top of your document.
4. Insert the following title in row 1. Remember to hold the Alt key and press enter at the end of each row to wrap the text in the cell.

Great Education College
Vehicles Sorted by Department
Report date: 7/1/2023

Integrity Check–Leave a blank row between report title and column headers
Remember that for a range of data to be able to sort, filter, create a table, that data cannot have cells containing other information immediately adjacent to the data headers.

As we progress through the rest of Chapter 5, we will modify the report title to reflect how we have modified our data.

Key Takeaways
• When creating a multi-level sort, decide your sort order first. • Create a multi-level (column) sort by using the Sort button in the Sort & Filter section of the Data tab. • A custom sort can be created from the Sort button, Order box, and typing anew list. • Custom sort lists are available across all your worksheets.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

5.3 Filtering Data

LEARNING OBJECTIVES
1. Duplicate worksheets. 2. Apply number and text filters to a data range. 3. Clear Filters

Georgia now wants to determine which vehicles should be considered for replacement. She is going to base her decision to replace a vehicle based on the age of the vehicle and the odometer reading. She wants you to filter so that only the vehicles that were purchased before 2017 and have an odometer reading greater than 100,000 miles are shown in the list.

Apply Filters

You could accomplish this by copying the worksheet and deleting all the rows of vehicles that don't meet her criteria, or you can filter the list to only show those vehicles that meet the given criteria. We will use filters to accomplish our goal.

When you create an Excel table, or turn on the Filter from the Data tab, the filter arrows appear next to the column headers. You can use the options on the AutoFilter to create three types of filters. You can filter a column of data by its cell colors or font colors, by a specific text, number, or date filter, (although the choices depend upon the type of data in the column,) or by selecting the exact values by which you want to filter in the column. After you filter a column, the Clear Filter command becomes available so you can remove the filter and redisplay all the records.

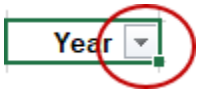
Follow-along file: Continue with Excel Objective 5.00. (Use file Excel Objective 5.05 if starting here.)

We will set up the filter for Georgia, but we want to maintain the first worksheet sort. We will accomplish this by duplicating our worksheet and performing the filter on the new worksheet.

1. While holding the Ctrl key down, left click the worksheet tab and drag to the right. You will see a little image of a piece of paper with a +. Drop the worksheet to the right of the original worksheet. The new worksheet will have the name College Vehicles (2).
2. Rename the worksheet Vehicle Filter.

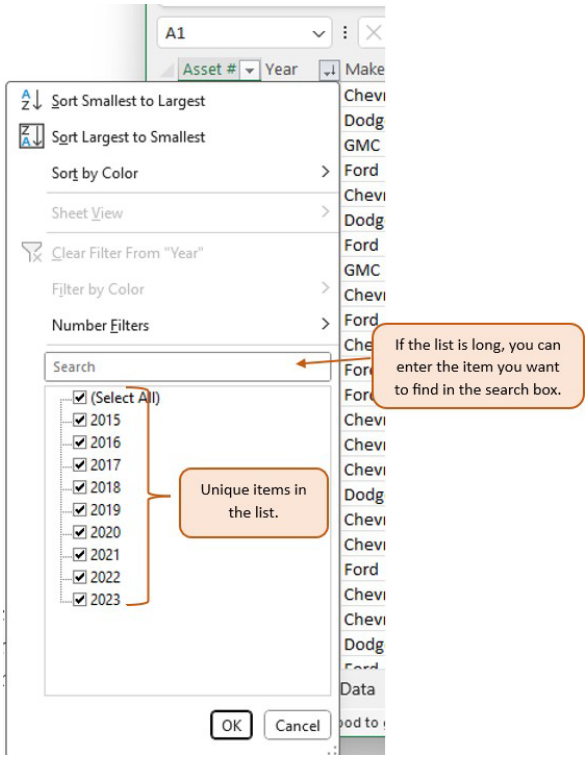
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

3. Make sure the Vehicle Filter worksheet is active by clicking on the worksheet tab at the bottom of the worksheet.
4. We will filter on the year first. It doesn't matter which category you decide to filter on first, the end results will be the same. Click the Category Filter arrow next to Year.



5. The AutoFilter menu opens as shown in Figure 5.8. It lists all the unique entries in the category. The list will differ based upon which column you select to filter.

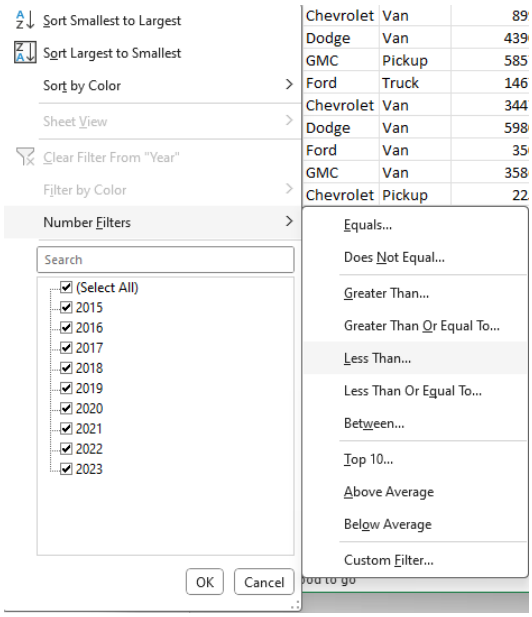
Figure 5.8: Filter Menu for the Year Column.



6. We could go through and uncheck all the years we don't want to filter on. In this case a vehicle newer than 2017, or we can use the number filter feature. Click on the Number Filter directly above the Search box. Because we are filtering on all cars older than 2017, we will Select Less Than from the drop-down menu.

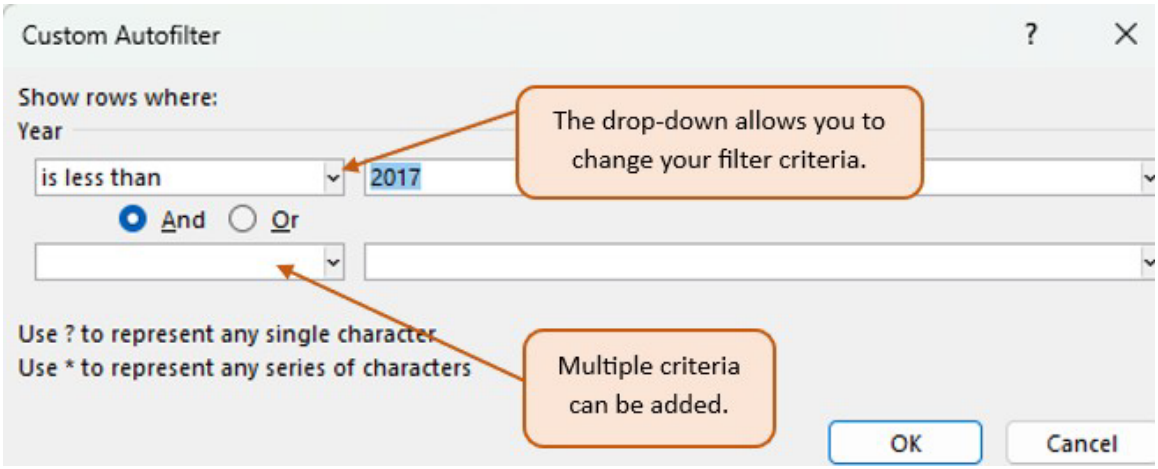
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 5.9: Number Filters Selection Menu.



7. In the Custom AutoFilter dialog box, type 2017 and click OK.

Figure 5.10: Custom AutoFilter Dialog Box.



8. The next filter we will apply will be for the odometer reading greater than 100,000 miles. Click on the Category Filter arrow next to Odometer and choose Number Filters, Greater than. Type 100000 (no commas) into the criteria value box. Click OK. Figure 5.10 shows the results of the number filters applied to the Year and Odometer columns.

Georgia decides that only the Dining Services department will get new vehicles this round, so she wants you to only show Dining Services in the report.

9. Click on the Category Filter next in the Department column. Note that the selection only shows those departments that are included in the filters that have been applied so far. Click the Select All so it is unchecked and then check Dining Services.

10. Click OK to save the filter.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 5.11: Selecting Departments.

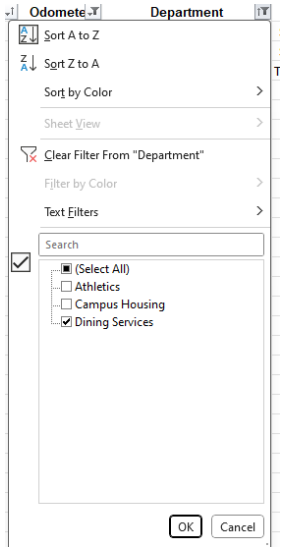
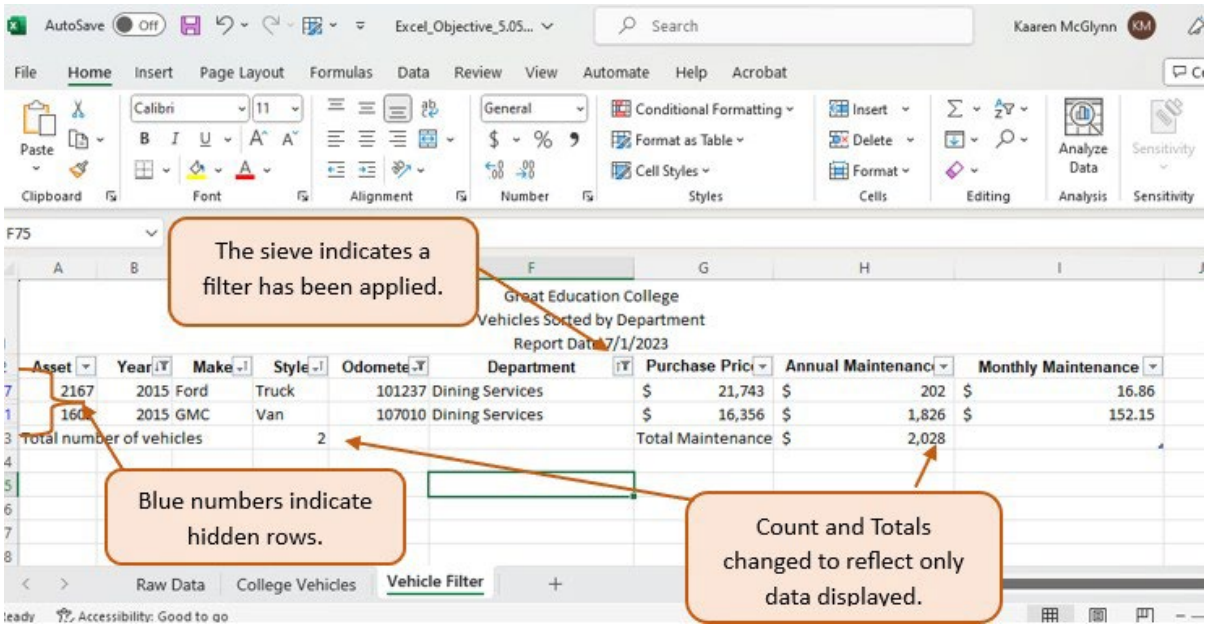


Figure 5.12 shows the results of the custom filters applied to the data. Note that the count of vehicles and the sum of the annual maintenance has changed to reflect only those vehicles included in the filter.

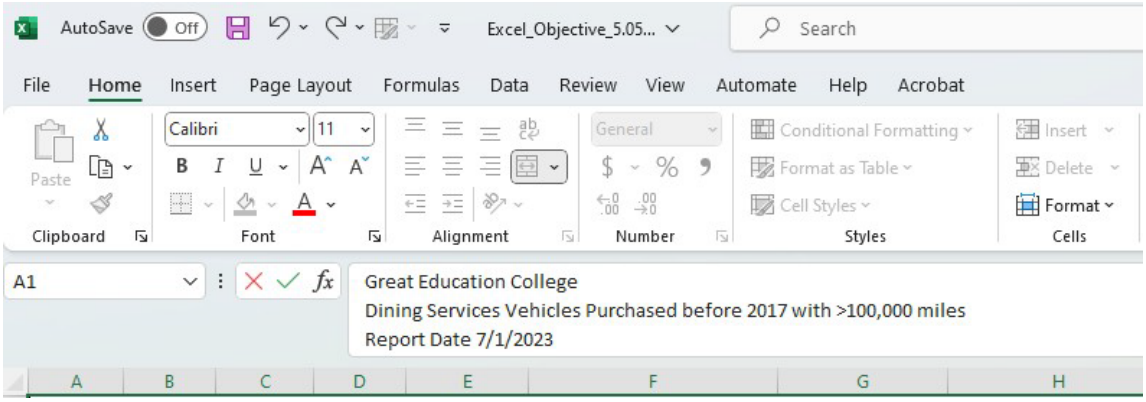
Figure 5.12: Worksheet After Filters Applied.



11. The title of the worksheet must be corrected to reflect the data filters applied. We will change the second row of the title to reflect this change. Click in the A1, the worksheet title. Use the down arrow at the right side of the formula bar to show the entire title.
12. Click in the second row and delete the text currently there. Replace that text with Dining Services. Vehicles Purchased before 2017 with > 100,000 miles.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 5.13: Worksheet Title Changed.



Skill Refresher – Adding a Data Filter
1. Click anywhere within your data or Excel table. (*Note: if you are not in an Excel table, click on the Filter button from the Filter & Sort section of the Data tab.)* 2. Click the AutoFilter button next to the column to be filtered. 3. Choose filter and then click OK.

Excel for Mac - Getting to hidden worksheet tabs
Command+Left click: Scroll to the first sheet (from right to left) Right arrow click: See all sheets

Clearing Filters

To redisplay all the data in a filtered table or data range, you need to clear or remove the filters. When you clear a filter from a column, all the other filters still applied will remain in place. To redisplay the entire data table, all the filters must be removed. You can remove filters one at a time or clear all filters.

To remove one at a time, click on the AutoFilter button next to the category you want to restore. From the drop-down select Clear Filter from…

To remove all filters, click on Clear Filters from the Sort & Filter section of the Data tab.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Key Takeaways
When you are working with a range of data or an Excel table that contains hundreds of thousands of records, filters help you find information quickly and efficiently without having to look at each individual record. For example, you could narrow the search to one student out of a student population of 40,000. Filtering limits the data to display only the specific records that meet the criteria you set, enabling you to analyze the data more effectively. The following examples further illustrate how filtering can narrow the data to only that data needed. • Looking for customers in a specific zip code, or range of zip codes. • Finding those records that have been highlighted by a specific color. • Searching by customers who purchased from you before a certain date so you can target them for a marketing campaign.

5.4 Structured Table References

LEARNING OBJECTIVES
1. Understand what a structured reference is in a Table. 2. Use specific areas within a Table in functions and formulas. 3. Creates dynamic arrays in functions to Table data. 4. Unlock the power of Tables

Using Structured References

Follow-along file: Continue with Excel Objective 5.00. (Use file Excel Objective 5.06 if starting here.)

Think of Structured References as names that refer to certain areas within a Table, for example, a specific column. Structured reference names begin with the Table name, followed by the specific Table area surrounded by square brackets []. For example, the name Table1[Amount] refers to the Amount column of a table named Table1.

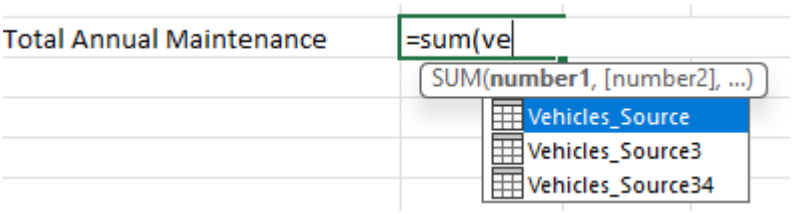
In addition to specific columns, you can refer to other areas within the Table, for example the header row, the data region, or the total row. Some of the most useful references are the column references and the header row. Here are many of the available references:

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

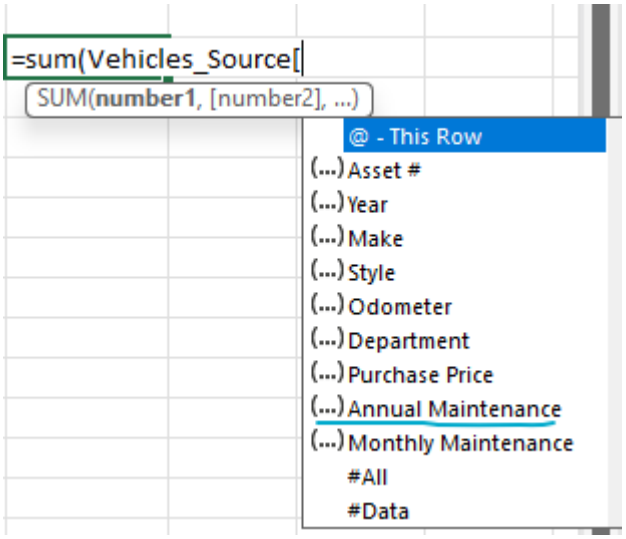
TableName[ColumnName] – refers to the specific column of data excluding the header row.
TableName[#All] – refers to all columns, including data, headers and total row, if any
TableName[#Data] – refers to all columns, data only (excludes header and total rows)
TableName[#Totals] – refers to total row only
TableName[@] – refers to the current row (the same row that this reference is in)

We will create structured table references to demonstrate how easy they are to create. The benefit of using them is that they are dynamic and will change whenever the table references change. This is also true if the table name is changed or any of the column names are changed. Formulas linked to the structured references will automatically update.

1. On the College Vehicles worksheet click in cell K2. Type in Total Annual Maintenance.
2. In L2 use the SUM function =SUM(start typing Vehi. You will see



3. Double click on Vehicles_Source. Enter a square bracket **[.** The list of table columns will now be visible.



Double click on Annual Maintenance. Close the structured reference with a closing square bracket **]**. Close the function.

4. Your function will look like this: =SUM(Vehicles_Source[Annual Maintenance]).

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

The table name will never be in square brackets. Only the column name will be in square brackets. Double clicking on the column name will insure that the name is correctly inserted into your function.

We will revisit this concept in Chapter 6 when discussing dynamic functions.

5.5 Subtotals

LEARNING OBJECTIVES
5. Convert a table to a normal range. 6. Sort data based on desired subtotal categories. 7. Create subtotals. 8. Create multi-level subtotals. 9. Subtotal views. 10. Remove subtotals.

Creating Subtotals

Follow-along file: Continue with Excel Objective 5.00. (Use file Excel Objective 5.07 if starting here.)

Georgia is helping the college president prepare her budget, and she needs a report she can give to the college president showing the number of each style of vehicle and the total annual maintenance cost by department. Using the total row in your table would mean creating a filter for each department and Style. Then printing each out in a separate report. You can create this report for her by creating subtotals in your worksheet.

We will summarize the data in our range by inserting subtotals. The subtotal command offers many kinds of summary commands. These include:

- Count
- Sum
- Average
- Maximums
- Minimums

There are a few major rules that must be followed before we can use the subtotal command. These are critical and include:

- Your data must be sorted in the order(s) you wish to create subtotals on. For instance, we want to create subtotals by department and by style within the department. Our sort levels would be department, then Style.

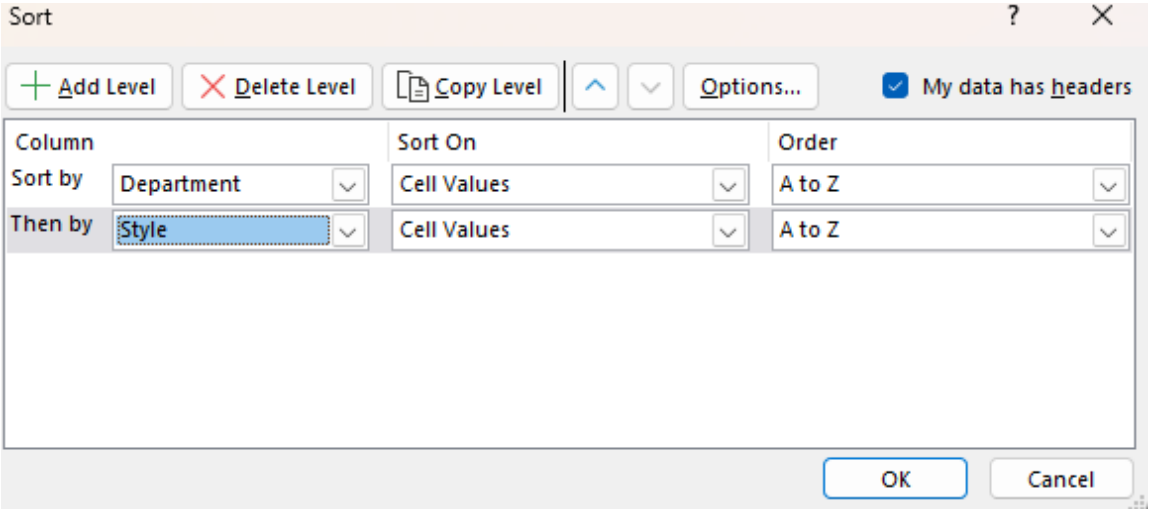
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

- If you have your data in an Excel table, that data must be converted to a range. You cannot perform subtotals on data in a table.

We will create these subtotals using the following steps.

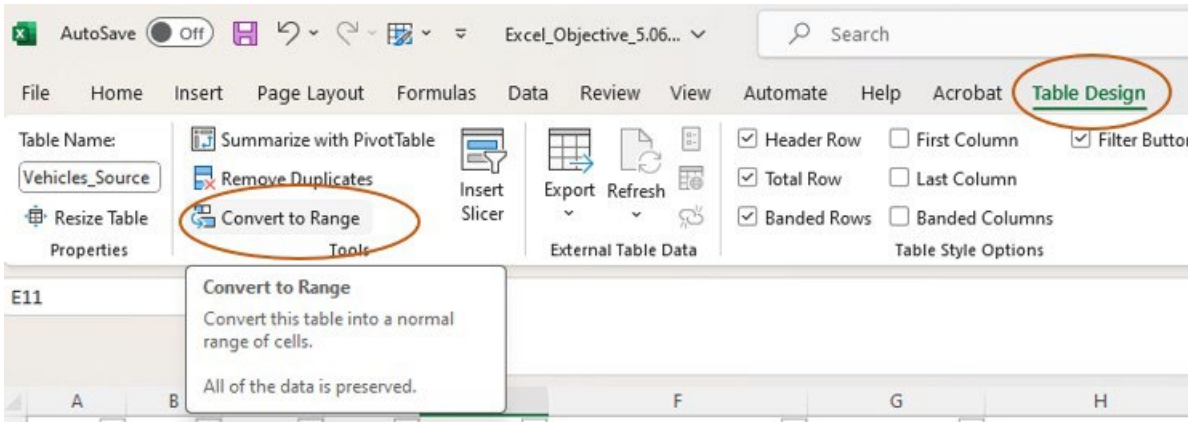
1. Copy the Raw Data worksheet by holding the Ctrl key down while left clicking the Raw Data worksheet tab and dragging the worksheet to the right of the Vehicle Filter worksheet.
2. Rename the new worksheet Vehicle Subtotals.
3. Create a multi-level sort by department and then by Style.

Figure 5.51: Multi-Level Sort for Subtotals.



4. Convert your Excel table to a range, (*Note: you would skip this step if your data is not in an Excel table.)* by clicking anywhere within the data. If your table has a total row, remove it by clicking on the check box in the Table Design ribbon.
   From the Table Tools Design click on Convert to Range in the Tools section.

Figure 5.52: Convert to a Range.

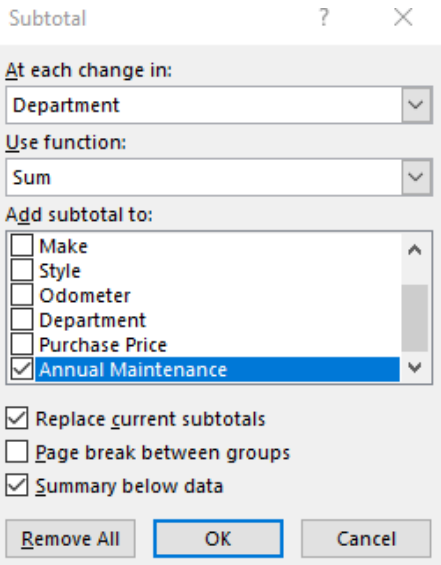


5. Click Yes when the warning box appears.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

6. From the Outline section of the Data tab, click on Subtotal. The first subtotal we will insert is the cost of annual maintenance by department.
7. From the Subtotal dialog box, in the At each change in: select Department from the drop-down. (This determines how the subtotals will be grouped.)
8. In the Use function box, select Sum. (This determines what operation will be performed.)
9. In the Add subtotal to: click on Annual Maintenance. Uncheck any box that maybe selected because we only want a subtotal for Annual Maintenance.
10. Click OK.

Figure 5.53: Completed Subtotal Dialog Box for Annual Maintenance by Department.

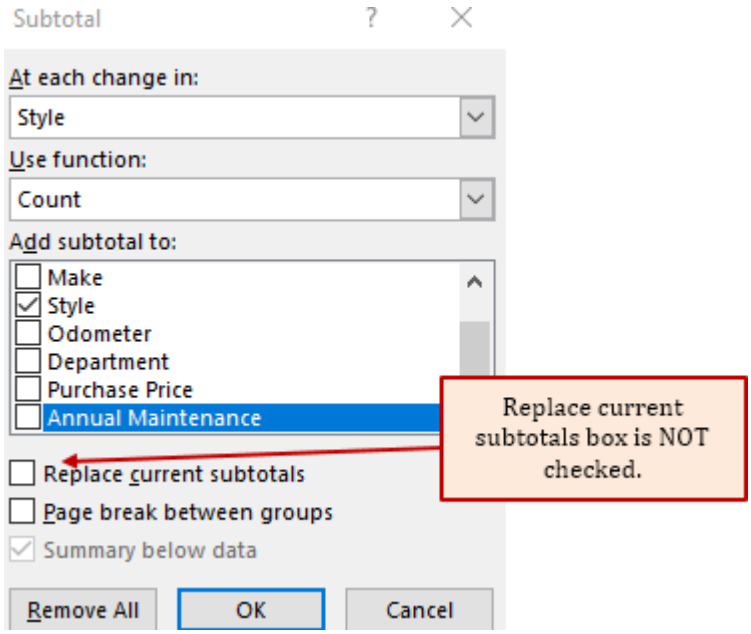


Next, we will add the count of vehicles by style to our subtotals. We will do that using the following steps.

1. Make any cell in your data range active. Click on Subtotal in the Outline section of the Data ribbon.
2. IMPORTANT: uncheck the box that says Replace current subtotals. If you do not, the new subtotal you create will erase the first one you did earlier.
3. We need to count the number of vehicles by style in each department. In the At each change in: select Style.
4. In the Use function: select Count. We want the number of each style vehicle in the department.
5. In the Add subtotals to: select Style and uncheck Annual Maintenance.
6. Click OK.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 5.54: Subtotal Dialog Box for Count of Style.



Next, we will add an appropriate title for our subtotal worksheet.

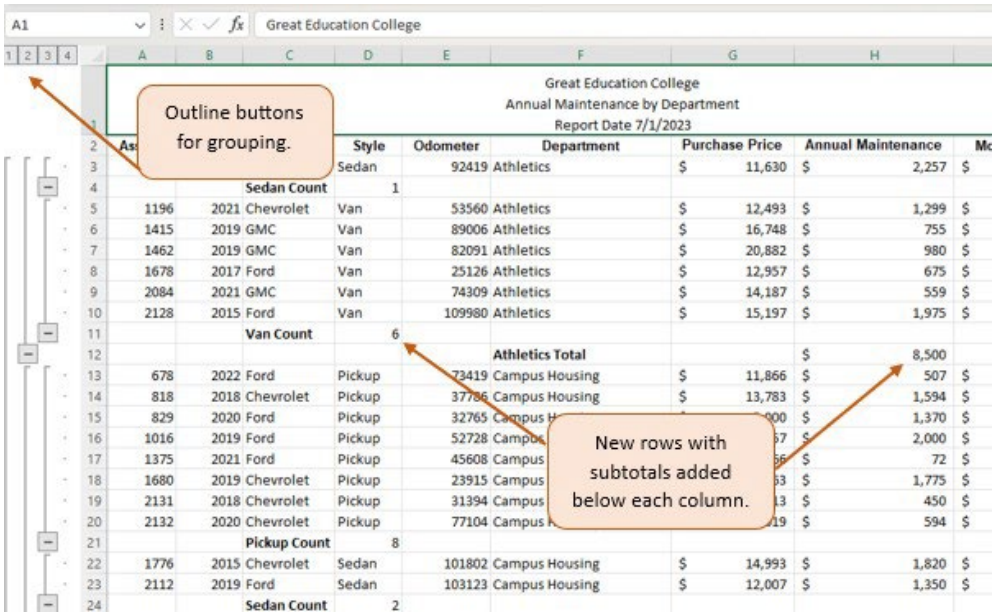
1. Click in the grey area of row 1 and drag down through row 2. This will select the entire rows 1 and 2. Hold the Ctrl key and click on the + key on your ten-key keypad, or Ctrl, Shift and the +, to insert two new rows.
2. Merge and center across cells A1:H1.
3. Add a new Row for the title. (Click on the 1 in the row number, ctrl+) Type the following title in A1. Remember to use Alt and Enter to move down a row inside cell A1.

   Great Education College
   Annual Maintenance by Department
   Report Date 7/1/2023

4. Enter to save the contents of the cell.
5. Resize row 1 so the entire title shows.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 5.55: Worksheet with Completed Subtotals.



Great Education College								
				Annual Maintenance by Department				
				Report Date 7/1/2023				
As			Style	Odometer	Department	Purchase Price	Annual Maintenance	Mc
			Sedan	92419	Athletics	$ 11,630	$ 2,257	$
		Sedan Count	1					
1196	2021	Chevrolet	Van	53560	Athletics	$ 12,493	$ 1,299	$
1415	2019	GMC	Van	89006	Athletics	$ 16,748	$ 755	$
1462	2019	GMC	Van	82091	Athletics	$ 20,882	$ 980	$
1678	2017	Ford	Van	25126	Athletics	$ 12,957	$ 675	$
2084	2021	GMC	Van	74309	Athletics	$ 14,187	$ 559	$
2128	2015	Ford	Van	109980	Athletics	$ 15,197	$ 1,975	$
		Van Count	6					
					Athletics Total		$ 8,500	
678	2022	Ford	Pickup	73419	Campus Housing	$ 11,866	$ 507	$
818	2018	Chevrolet	Pickup	37786	Campus Housing	$ 13,783	$ 1,594	$
829	2020	Ford	Pickup	32765	Campus H	000	$ 1,370	$
1016	2019	Ford	Pickup	52728	Campu	67	$ 2,000	$
1375	2021	Ford	Pickup	45608	Campus	66	$ 72	$
1680	2019	Chevrolet	Pickup	23915	Campus	63	$ 1,775	$
2131	2018	Chevrolet	Pickup	31394	Campus	13	$ 450	$
2132	2020	Chevrolet	Pickup	77104	Campus	19	$ 594	$
		Pickup Count	8					
1776	2015	Chevrolet	Sedan	101802	Campus Housing	$ 14,993	$ 1,820	$
2112	2019	Ford	Sedan	103123	Campus Housing	$ 12,007	$ 1,350	$
		Sedan Count	2					

Skill Refresher - Subtotals
1. Sort the data by the column(s) for which you want a subtotal.
2. If the data is in an Excel table, convert the data to a normal range.
3. In the Outline group of the Data tab, click on Subtotal.
4. Click the At each change in arrow, select the column your subtotals will group on.
5. Click the Use function arrow and then select the function to be used.
6. In the Add Subtotal to box check the fields you want to add subtotals to.
7. If you are adding additional subtotals, uncheck the Replace current subtotals box.
8. Click OK.

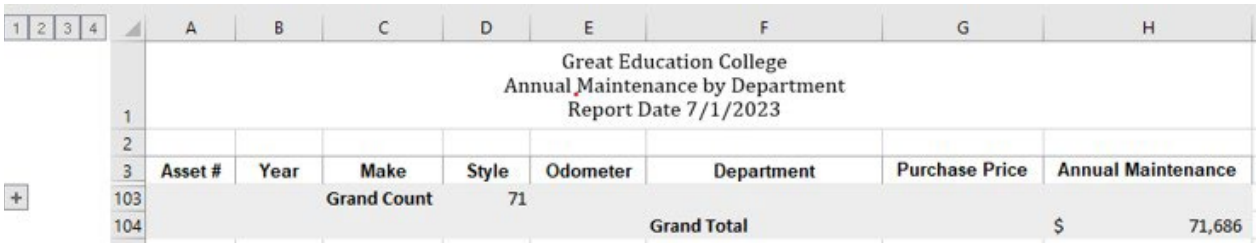
Subtotal Outline View

In addition to displaying subtotals your Subtotal feature creates outline views. Figure 5.56b shows the outline buttons that are created when a worksheet has the subtotal feature applied. It will show or hide different levels of detail in your worksheet.

1. Level 1: only the grand total shows.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

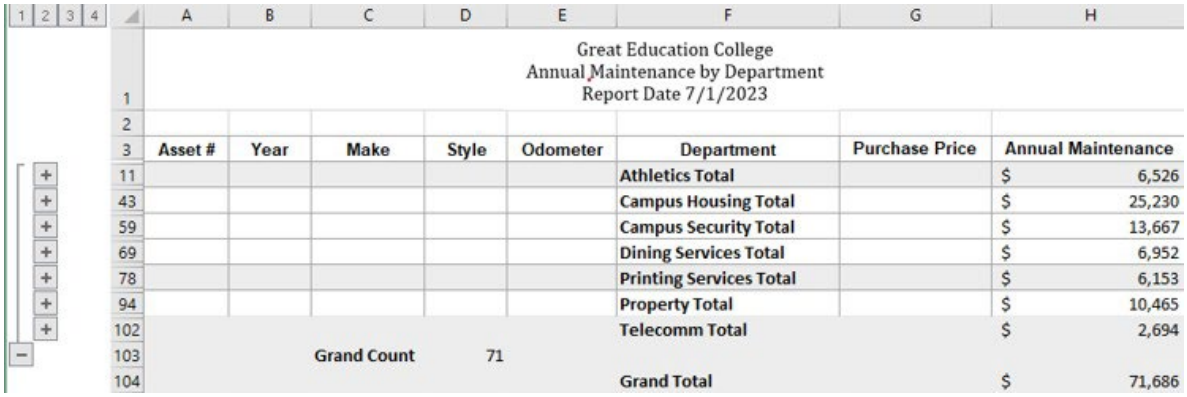
Figure 5.56a: Grand Total View.



	A	B	C	D	E	F	G	H
1	Great Education College Annual Maintenance by Department Report Date 7/1/2023							
2								
3	Asset #	Year	Make	Style	Odometer	Department	Purchase Price	Annual Maintenance
103			Grand Count	71				
104						Grand Total		$ 71,686

2. Level 2: totals for each of the main categories will show.

Figure 5.56b: Department Annual Maintenance Subtotals.



	A	B	C	D	E	F	G	H
1	Great Education College Annual Maintenance by Department Report Date 7/1/2023							
2								
3	Asset #	Year	Make	Style	Odometer	Department	Purchase Price	Annual Maintenance
11						Athletics Total		$ 6,526
43						Campus Housing Total		$ 25,230
59						Campus Security Total		$ 13,667
69						Dining Services Total		$ 6,952
78						Printing Services Total		$ 6,153
94						Property Total		$ 10,465
102						Telecomm Total		$ 2,694
103			Grand Count	71				
104						Grand Total		$ 71,686

Level 3: will show if you have secondary subtotals. In the case of the college's vehicles, we have a secondary sort by style, so our level 2 view shows the subtotals for both Department and Style.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 5.56c: Department and Style Subtotals.

	A	B	C	D	E	F	G	H
1	Great Education College Annual Maintenance by Department Report Date 7/1/2023							
2								
3	Asset #	Year	Make	Style	Odometer	Department	Purchase Price	Annual Maintenance
5			Sedan Count	1				
10			Van Count	4				
11						Athletics Total		$ 6,526
20			Pickup Count	8				
23			Sedan Count	2				
29			Truck Count	5				
42			Van Count	12				
43						Campus Housing Total		$ 25,230
45			Pickup Count	1				
55			Sedan Count	9				
58			Van Count	2				
59						Campus Security Total		$ 13,667
61			Pickup Count	1				
63			Truck Count	1				
68			Van Count	4				
69						Dining Services Total		$ 6,952
71			Pickup Count	1				
73			Sedan Count	1				
77			Van Count	3				
78						Printing Services Total		$ 6,153
83			Pickup Count	4				
86			Sedan Count	2				
88			Truck Count	1				
93			Van Count	4				
94						Property Total		$ 10,465

3. Level 4: shows the entire data set with subtotals. (Figure 5.56c)

In short, the higher the level showing the more condensed the data will be. As you move higher, more and more of the data will be revealed.

- Level 1 shows the grand total only.
- Level 2 shows the main category subtotal.
- Level 3 shows subtotals for each major and secondary subtotals (if more than one subtotal applied.)
- Level 4 (in this example) shows all the data and subtotals.

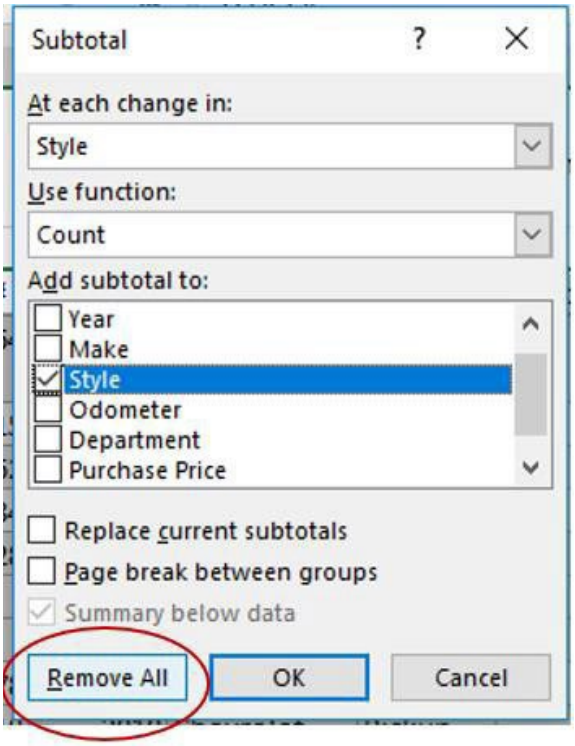
Removing Subtotals

To remove the subtotal from a worksheet you must use the Subtotal button from the Outline section of the Data tab. *Note: Clicking on Undo will not remove subtotals*.

Click Remove All from the lower left corner of the Subtotal Dialog box. See Figure 5.19.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 5.57: Removing Subtotals.



Key Takeaways
• Data that is in a table must be converted back to a range before creating SUBTOTALS. • Create the data sort before creating SUBTOTALS • If creating multi-level subtotals, the second set of subtotals must have the check box for Replace current subtotals unchecked. • To remove all subtotals, open the SUBTOTALs dialog box from the Data tab and click on the Remove All button.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

EXERCISES
1. When performing a single level Subtotal what step is not needed? a. Convert table to a range. b. Sort column that will be used to determine what to subtotal on. c. Make sure the "Replace Subtotal" box is checked. d. All steps are needed. 2. An Excel table includes records for 500 employees. What can you use to calculate the average salary of employees in the finance department? a. Average function b. Add a total row to the table and change the function to Average. c. Filter the data so only finance department is visible, then apply the Average. d. All of the above. 3. The count function is a valid subtotal function when using the Subtotal command. a. True b. False

5.6 PivotTables and PivotCharts

LEARNING OBJECTIVES
1. Create a PivotTable 2. Format the PivotTable 3. Rearrange a PivotTable. 4. Create Slicers and Timelines 5. Create PivotCharts

An Excel worksheet can contain thousands upon thousands of rows and columns of data. The amount of data can be overwhelming to try to assimilate and make sense of. There is a wealth of information that can be obtained by using the right tools to condense and organize your data.

A PivotTable summarizes data using the COUNT, SUM, AVERAGE, MIN and MAX functions. For example, Georgia wants you to prepare a presentation for the budget committee that will summarize the college vehicles data. She wants her report to show total cost of annual maintenance by department and age of the vehicles.

Creating a PivotTable

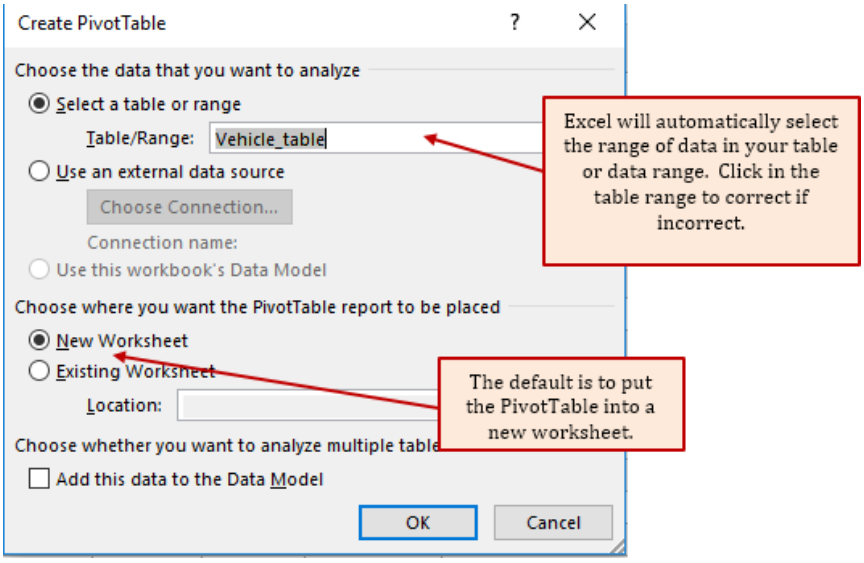
Follow-along file: Continue with Excel Objective 5.00. (Use file Excel Objective 5.08 if starting here.)

We will create a PivotTable to reflect Georgia's report needs. The steps to complete the PivotTable are:

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

1. Click on the Raw Data worksheet tab to activate the worksheet. Make any cell active in your data range or table.
2. Click on PivotTable from the Tables section of the Insert tab. The Create PivotTable dialog box will appear.

Figure 5.20: Create PivotTable Dialog Box.


Create PivotTable
Choose the data that you want to analyze
Select a table or range
Table/Range: Vehicle_table
Use an external data source
Choose Connection...
Connection name:
Use this workbook's Data Model
Choose where you want the PivotTable report to be placed
New Worksheet
Existing Worksheet
Location:
Choose whether you want to analyze multiple table
Add this data to the Data Model
OK
Cancel
Excel will automatically select the range of data in your table or data range. Click in the table range to correct if incorrect.
The default is to put the PivotTable into a new worksheet.

3. Accept the defaults and click OK.
4. A new worksheet is created to the left of your Raw Data worksheet. Click and drag the worksheet tab to the right of the Vehicle Subtotal worksheet. Rename the worksheet Vehicle PivotTable.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 5.21: New PivotTable Worksheet Elements.

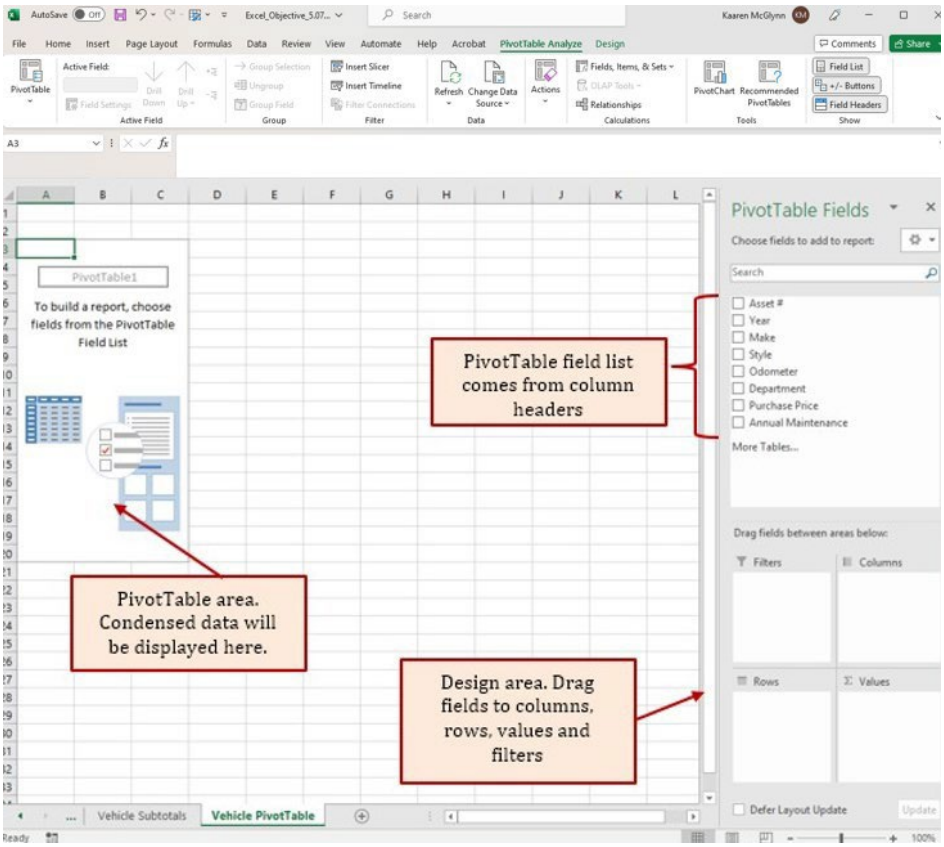


Figure 5.21 shows the PivotTable elements. We are going to create the PivotTable by dragging fields from the field list into the design area in the lower right section.

5. The first field we will drag down is the department field. Drag the field into the Rows area by clicking on the field name, holding left mouse, and dragging to Rows. As soon as you release the mouse you will see the departments appear in the PivotTable area.
6. We will put the vehicle year field into the columns section of the pivot table by dragging it to Columns.
7. Georgia is looking for annual maintenance on the vehicles, so drag the annual maintenance field to the Values section of the design area.

Rearranging a PivotTable

In evaluating the layout for the PivotTable, Georgia determines she would rather see the years going down the rows and the departments as the columns. We will drag and drop the fields to recreate the chart.

8. Click on Department in the Rows section and drag it up into the Columns area.
9. Click on the Year in the Columns section and drag it down to rows. This makes the information easier to read.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

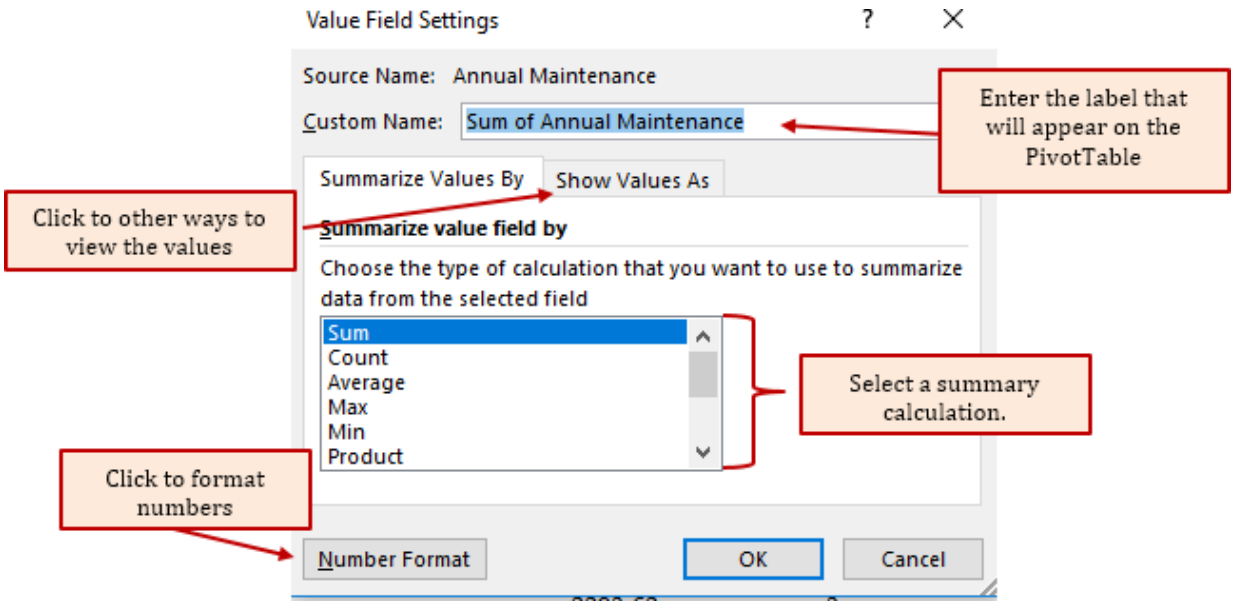
10. Click on Annual Maintenance. Excel will place it in the Values box. In looking at the data, it is difficult to determine how many vehicles the data applies to. Georgia asks you to include a count of the vehicles in your layout.
11. Drag the Style field into the Values section. Since the Style field contains text, Excel automatically applies a COUNT to the data.

Georgia likes this layout, but now it needs to be formatted and titled for a professional presentation.

Value Field Settings

12. Click any cell in the Sum of Annual Maintenance column of the PivotTable report.
13. Left click the Sum of Annual maintenance field in the Values section. Select Value Field Settings from the drop-down menu.

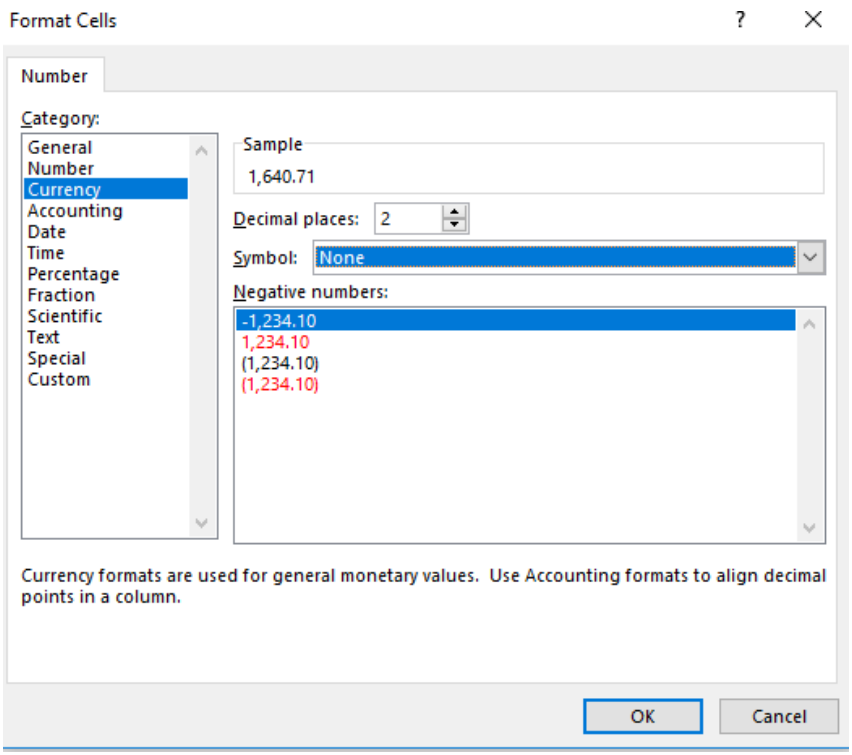
Figure 5.22: Value Fields Settings dialog box.



14. The field name is too wide and makes the PivotTable look long and drawn out. Change the Custom Name to Maint. Cost.
15. Click on Number Format and change the number format to Currency. In the symbol box select None from the drop-down. See Figure 5.23.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 5.23: Changing the Number Format for Annual Maintenance.



16. Click OK to accept the Format Cells changes.
17. Click Ok to accept all changes to the Annual Maintenance field in the PivotTable.
18. Left click on the Count of Style field in the Values layout. Select Value Field Settings.
19. Change the Custom Name to No. of Vehicles. Click OK to close the dialog box.

PivotTable Formatting

PivotTables are inherently ugly and require a bit of formatting to make them easily understandable to the reader. Remember, it must tell its own story.

20. Click in cell B3. In the formula bar type; Department: Hit Enter.
21. Click in cell A5. In the formula bar type: Year Purchased. Hit Enter. Wrap text in A5.
22. Georgia wants to see the No. of vehicles before the maintenance cost. In the Values section of the Pivot table design area, drag and drop the No. of Vehicles field above the Maint. Cost.
23. Highlight B4:C24 and apply an outside border. Repeat this step for each of the departments across the page.
24. The last formatting change we will make to our PivotTable is the worksheet title. We already have a blank row in row 1, so adding a row is not needed.
25. Select the range A1:Q1. Merge and Center the row.
26. Type the following title into A1.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Great Education College
Annual Maintenance by Department
Report Date 7/1/2023

27. Resize Row 1 to fit the 3-line title.

Breat Educaton College
Annual Maintenance by Department
Report Date 7/1/2023

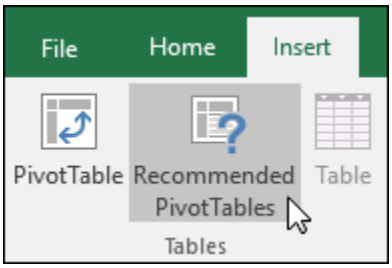
Year Purchased	Department: Athletics Styles	Athletics Maint. Cost	Campus Housing Styles	Campus Housing Maint. Cost	Campus Security Styles	Campus Security Maint. Cost	Dining Services Styles	Dining Services Maint. Cost	Printing Services Styles	Printing Services Maint. Cost	Property Styles	Property Maint. Cost
2015	1	1,974.79	1	1,820.00	1	1,871.00	4	5,231.61				
2016			1	117.64	1	489.92	1	1,025.00			1	279.12
2017	1	675.00	5	1,997.77	1	566.94					3	2,239.86
2018	1	2,257.16	4	4,134.12	1	111.87			2	2,369.55	3	2,125.62
2019	2	1,735.00	6	10,190.92	3	3,710.07						
2020			3	2,343.64	1	1,932.76			1	378.22		
2021	2	1,857.62	4	2,144.72					2	3,405.51	2	2,575.00
2022			1	507.00	3	3,145.28						
2023							1	694.89			2	3,245.08
Grand Total	**7**	**8,499.57**	**25**	**23,255.81**	**11**	**11,827.84**	**6**	**6,951.50**	**5**	**6,153.28**	**11**	**10,464.68**

Recommended PivotTables

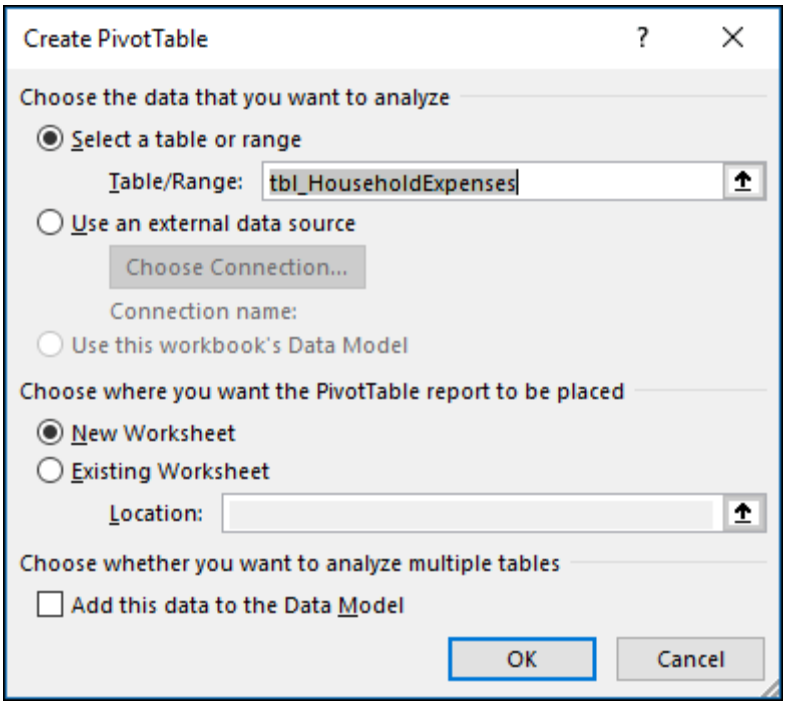
If you have limited experience with PivotTables, or are not sure how to get started, a Recommended PivotTable is a good choice. When you use this feature, Excel determines a meaningful layout by matching the data with the most suitable areas in the PivotTable. This helps give you a starting point for additional experimentation. After a Recommended PivotTable is created, you can explore different orientations and rearrange fields to achieve your specific results.

Recommended PivotTable

Click a cell in the source data or table range. Go to **Insert** > **Tables** >**Recommended PivotTable**.



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International



In the **Choose where you want the PivotTable report to be placed** section, select **New Worksheet**, or **Existing Worksheet**. For **Existing Worksheet**, you'll need to select both the worksheet and the cell where you want the PivotTable placed.

If you want to include multiple tables or data sources in your PivotTable, click the **Add this data to the Data Model** check box.

Click **OK**, and Excel will create a predesigned PivotTable, and display the **PivotTable Fields** list.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Slicers and Timelines

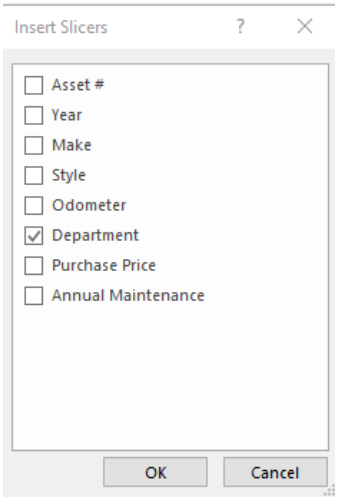
Slicers

Slicers are a tool in Excel Pivot tables and Excel tables that inserts a slicer on the face of the worksheet to easily filter out data. You can select a slicer from any field in the PivotTable, or table.

Now that we have the PivotTable report finalized, we will add a slicer that will make it easy to filter data by Department. The steps we will use are:

1. Click anywhere in the PivotTable to activate the PivotTable Tools Ribbon.
2. Click on Insert Slicer from the Filter section of the Analyze tab of the PivotTableTools.
3. The Insert Slicers dialog box will appear. Click on Department to create a slicer for the department.

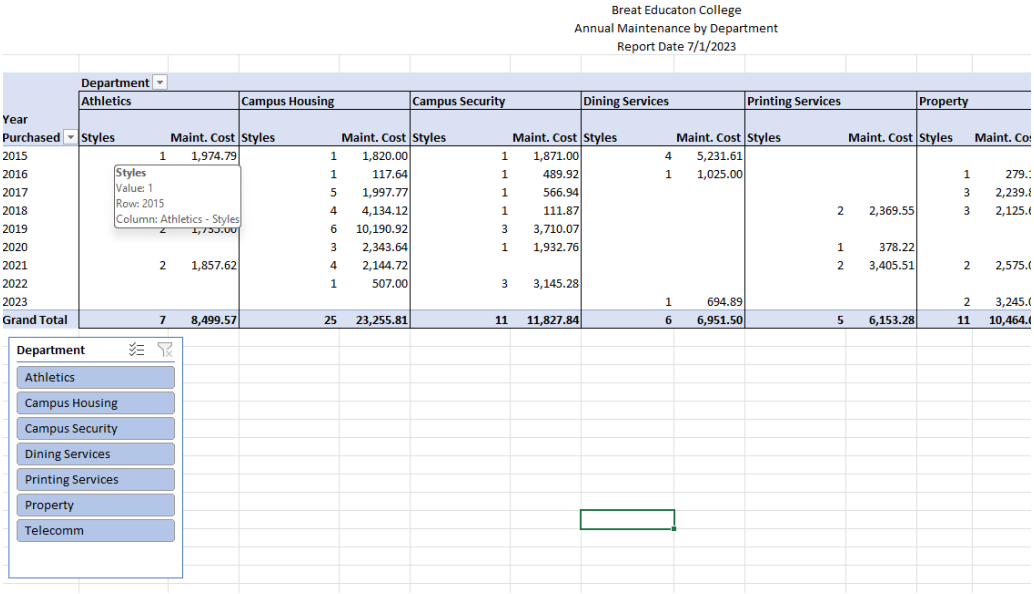
Figure 5.24: Insert Slicer Dialog Box.



4. Click OK.
5. Move the slicer so it is positioned below the PivotTable.
6. Click on a department to filter out all the other departments. You can select multiple departments by holding down the Ctrl key and clicking on departmentnames.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 5.25: Completed PivotTable with Slicer.



Breat Educaton College
Annual Maintenance by Department
Report Date 7/1/2023

Year Purchased	Department: Athletics Styles	Athletics Maint. Cost	Campus Housing Styles	Campus Housing Maint. Cost	Campus Security Styles	Campus Security Maint. Cost	Dining Services Styles	Dining Services Maint. Cost	Printing Services Styles	Printing Services Maint. Cost	Property Styles	Property Maint. Co
2015	1	1,974.79	1	1,820.00	1	1,871.00	4	5,231.61				
2016			1	117.64	1	489.92	1	1,025.00			1	279.
2017			5	1,997.77	1	566.94					3	2,239.
2018			4	4,134.12	1	111.87			2	2,369.55	3	2,125.
2019			6	10,190.92	3	3,710.07						
2020			3	2,343.64	1	1,932.76			1	378.22		
2021	2	1,857.62	4	2,144.72					2	3,405.51	2	2,575.
2022			1	507.00	3	3,145.28						
2023							1	694.89			2	3,245.
Grand Total	7	8,499.57	25	23,255.81	11	11,827.84	6	6,951.50	5	6,153.28	11	10,464.

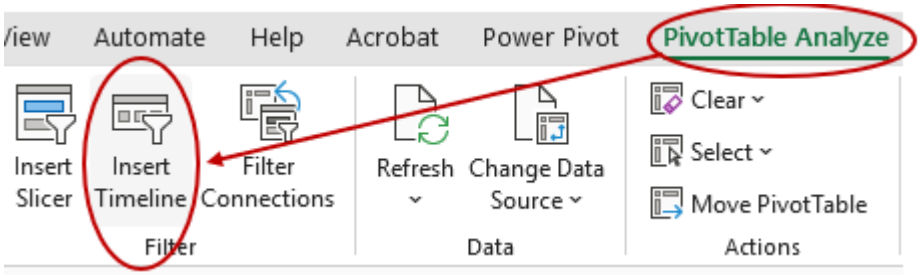
Styles
Value: 1
Row: 2015
Column: Athletics - Styles

Department
Athletics
Campus Housing
Campus Security
Dining Services
Printing Services
Property
Telecomm

Timelines

Timelines are like Slicers in that they give you a way to parse, (analyze or extract exact information), information from a table or PivotTable. The table or PivotTable must contain a date field to insert a timeline. If your data does not contain a date field you will get an error telling you that a date field must be present.

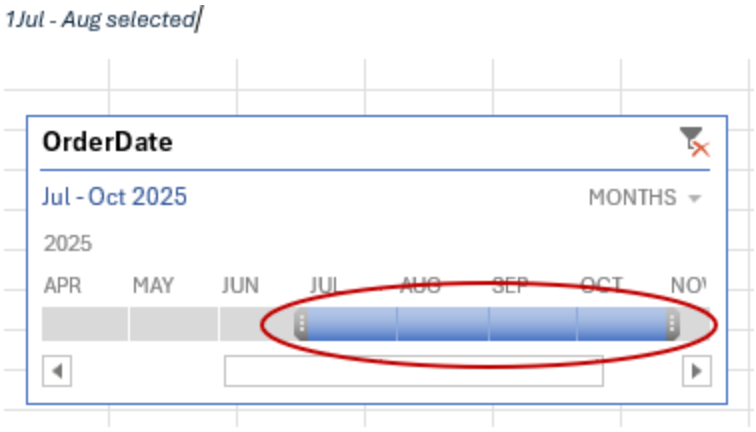
In a table or PivotTable that contains a date field select , click anywhere in the data. Go to the Table or PivotTable Analyze tab. Click on Timeline.



A timeline will be inserted on the face of the worksheet containing the data. The timeline can be repositioned by clicking and dragging on it.

When initially displayed, the timeline will show the entire timeline. The timeline can be filtered by dragging on either end of the blue timeline bar

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International



Key Takeaways
• Slicers can be use on column or row header data. • Timelines can only be used when the data contains dates or times

Group or ungroup data in a PivotTable

With Excel 365, Grouping date data in a PivotTable is done automatically for you when you drag the date field into rows or columns on the Pivot Table. It can help you show a subset of data to analyze. For example, you may want to group an unwieldy list of dates or times (date and time fields in the PivotTable) into quarters and months, like this:

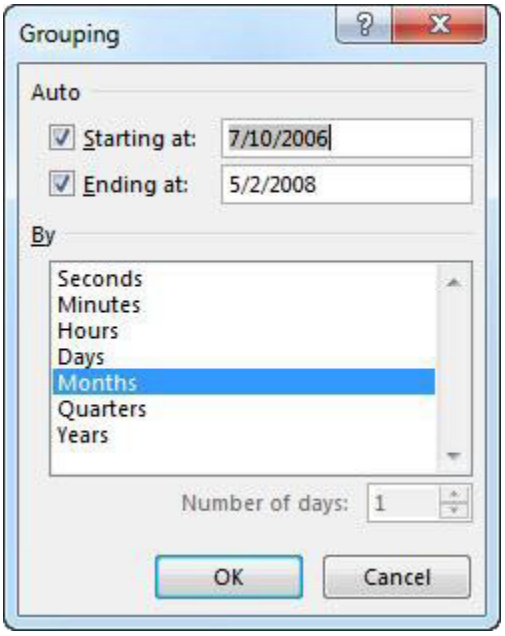
Note: The time grouping feature was new in Excel 2016. With time grouping, relationships across time-related fields are automatically detected and grouped together

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

when you add rows of time fields to your PivotTables. Once grouped together, you can drag the group to your Pivot Table and start your analysis.

Group fields

1. In the PivotTable, right-click any numeric or date and time field and click **Group**.
2. In the **Starting at** and **Ending at** box, enter this (as needed):



   - The smallest and largest number to group numeric fields.
   - The first and last date or time you want to group by.

The entry in the **Ending at** box should be larger or later than the entry in the **Starting at** box.

3. In the **By** box, do this:
   - For numeric fields, enter the number that represents the interval for each group.
   - For date or time fields, click one or more date or time periods for the groups.

You can click additional time periods to group by. For example, you can group by **Months** and **Weeks**. Group items by weeks first, making sure **Days** is the only time period selected. In the **Number of days** box, click **7**, and then click **Months**.

Tip: Date and time groups are clearly labeled in the PivotTable; for example, as **Apr**, **May**, **Jun** for months. To change a group label, click it, press F2, and type the name you want.

Group date and time columns automatically (time grouping) Note: The time grouping feature is available in Excel 2016 and later only.

- In the **PivotTable Fields** task pane, drag a date field from the Fields area to the Rows or Columns areas to automatically group your data by the time period.

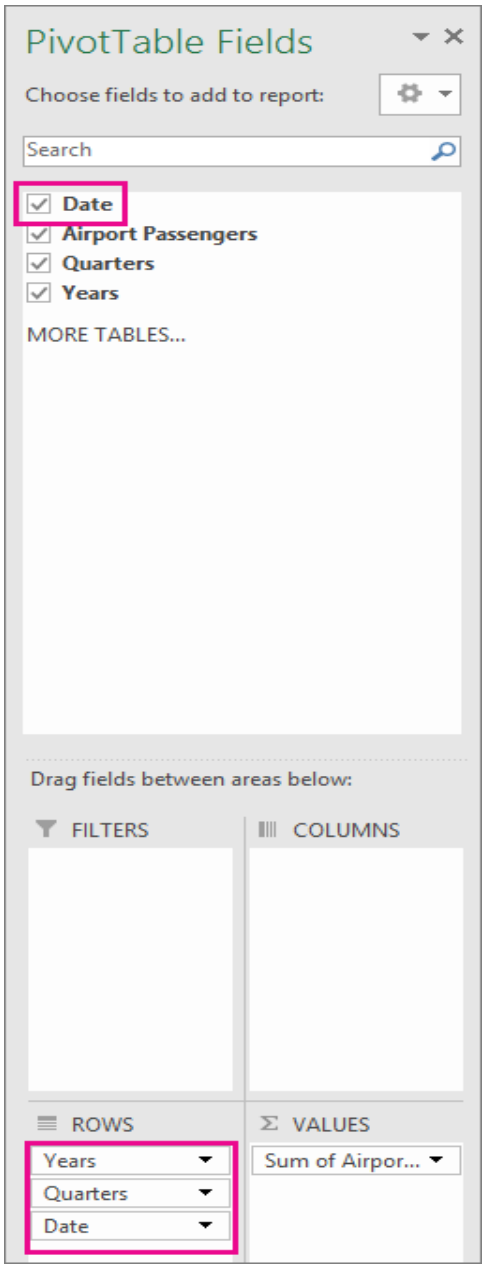
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

PivotTable Field List before time grouping

Excel automatically adds calculated columns to the PivotTable used to group the date or time data. Excel will also auto collapse the data to show it in its highest date or time periods.

For example, when the Date field is checked in the Fields list above, Excel automatically adds Year, Quarter, and month (Date) as shown below.

PivotTable Field List after time grouping



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Notes:

- The Years or quarters can be displayed individually by dragging the date field and unwanted fields off the rows selection.
- When you drag a date field from the Field List to the Rows or Columns area where a field already exists, and then put the date field above the existing field, the existing date field is removed from the Row or Columns area and the data won't be automatically collapsed so you can see this field when collapsing the data.
- For a data model PivotTable, when you drag a date field with over one thousand rows of data from the Field List to the Rows or Columns areas, the Date field is removed from the Field List so Excel can display a PivotTable that overrides the one million records limitation.

Group selected items

You can also select specific items and group them, like this:

1. In the PivotTable, select two or more items to group together, holding down Ctrl or Shift while you click them.
2. Right-click what you selected and click **Group**.

When grouping selected items, a new field is created based on the field being grouped. For example, when a field called **SalesPerson** is grouped, a new field is created called **SalesPerson1**. This field is added to the field section of the Field List, and can be used like any other field in the Pivot Table. In the PivotTable, you'll see a group label, like **Group1**

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

for the first group you create. To change a group label to something more meaningful, click it, > **Field Settings**, and in the **Custom Name** box, type the name you want.

Tips:

- For a more compact PivotTable, you might want to create groups for all the other ungrouped items in the field.
- For fields that are organized in levels, you can only group items that all have the same next-level item. For example, if the field has levels Country and City, you can't group cities from different countries.

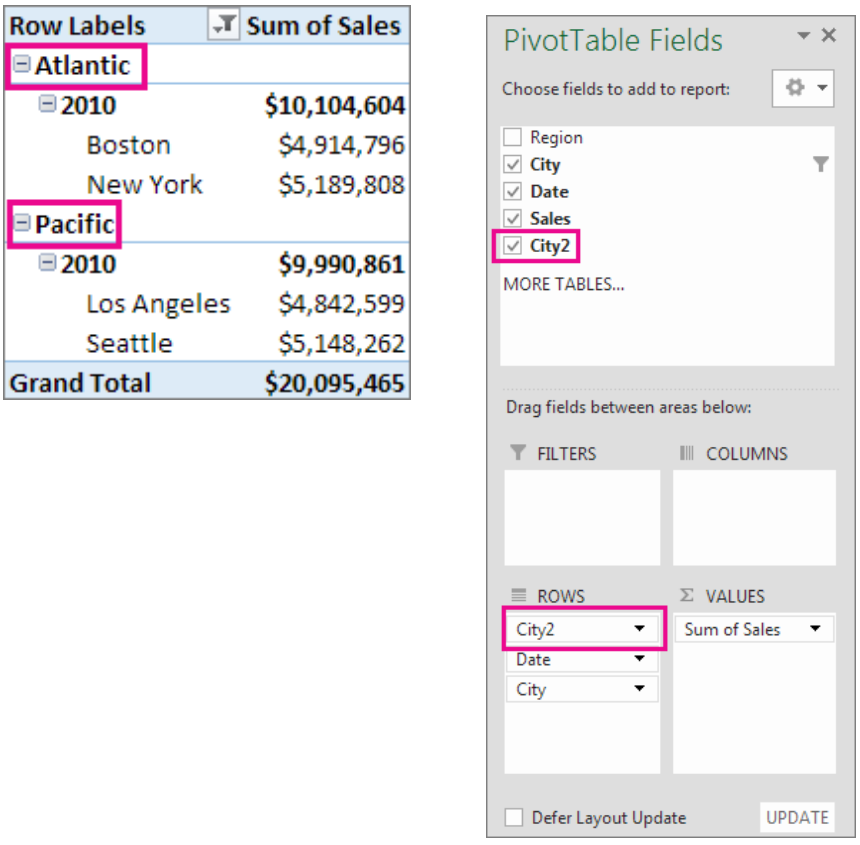
Ungroup grouped data

To remove grouping, right-click any item in the grouped data, and click **Ungroup**.

If you ungroup numeric or date and time fields, all grouping for that field is removed. If you ungroup a group of selected items, only the selected items are ungrouped. The group field won't be removed from the Field List until all groups for the field are ungrouped. For example, suppose you have four cities in the City field: Boston, New York, Los Angeles, and Seattle. You group them so that New York and Boston are in one group you name Atlantic, and Los Angeles and Seattle are in a group you name Pacific. A new field, City2, appears in the Fields area and is placed in the Rows area of the Fields List.

As shown here, the City2 field is based on the City field, and is placed in the Rows area to group the selected cities.

As shown below, the four cities are arranged under the new groups, Atlantic and Pacific.



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Note: When you undo time grouped or auto collapsed fields, the first undo will remove all the calculated fields from the field areas leaving only the date field. This is consistent with how PivotTable undo worked in previous releases. The second undo will remove the date field from the field areas and undo everything.

About grouping data in a PivotTable

When you group data in a PivotTable, be aware that:

- You can't add a calculated item to an already grouped field. You first need to ungroup the items, add the calculated item, and then regroup the items.
- You can't create slicers with grouped fields.
- Excel 2016 only: You can turn off time grouping in PivotTables (including data model PivotTables) and Pivot Charts by editing your registry.

PivotCharts

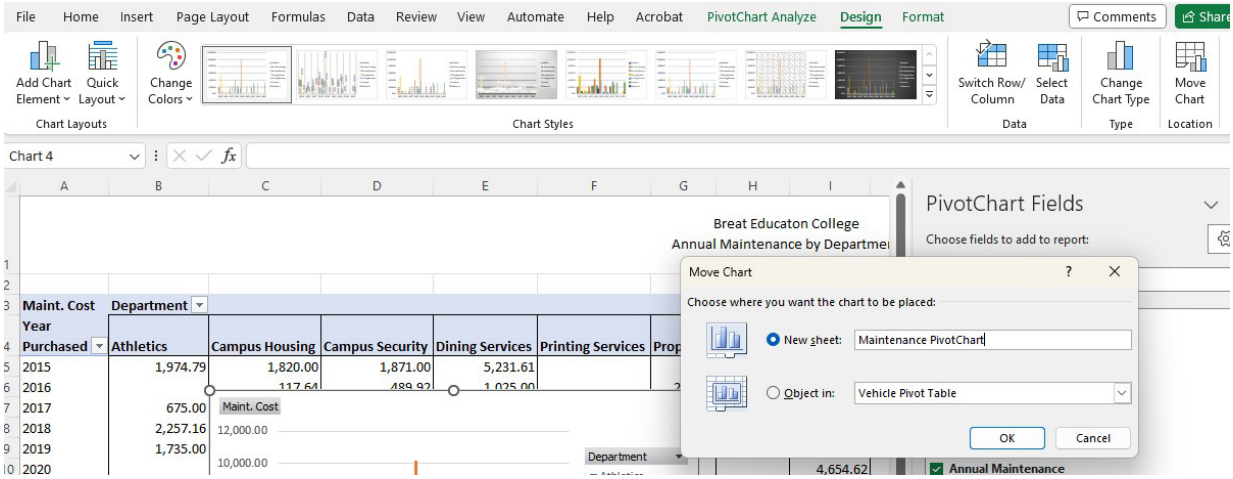
Georgia would like you to create a chart for her that graphically shows the cost by department. Because of the disparate values between maintenance cost and number of vehicles for each department, the data in the Vehicle PivotTable would not create a clear and informative PivotChart. We will make a copy of the Vehicle PivotTable worksheet and use the copy to build our PivotChart.

1. Click on the Vehicle PivotTable tab, hold the Ctrl key down while dragging to the right.
2. Rename the new Vehicle PivotTable(2) to Vehicle PivotChart.
3. If the PivotTable Field list is not showing, click anywhere in the PivotTable, from the Show section of the Analyze PivotTable Tools tab, click the Field List button.
4. On the copied PivotTable, in the PivotTable name box on the Analyze tab of the PivotTable tools, rename the PivotTable1 to PivotTable 2. *Note: if you don't rename the PivotTable, it will be linked to the first PivotTable.*
5. To eliminate the number of vehicles from our PivotTable we can create a meaningful chart, drag the No. of Vehicles field out of the Values section. Your PivotTable will now just show the annual maintenance cost by department and year.
6. Click the PivotChart button from the Analyze PivotTable Tools tab.
7. Select the Clustered Column chart type.
8. From the PivotTable Tools Design tab, click the Move Chart button. Move the Pivot Chart to its own chart sheet called Maintenance PivotChart.

Key Takeaways
• New fields can be created by using Group Data. • Data containing dates/times will automatically be grouped but can be broken down into desired components: year/quarter/week, etc..

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 5.26: Move the PivotChart to a New PivotChart Sheet.



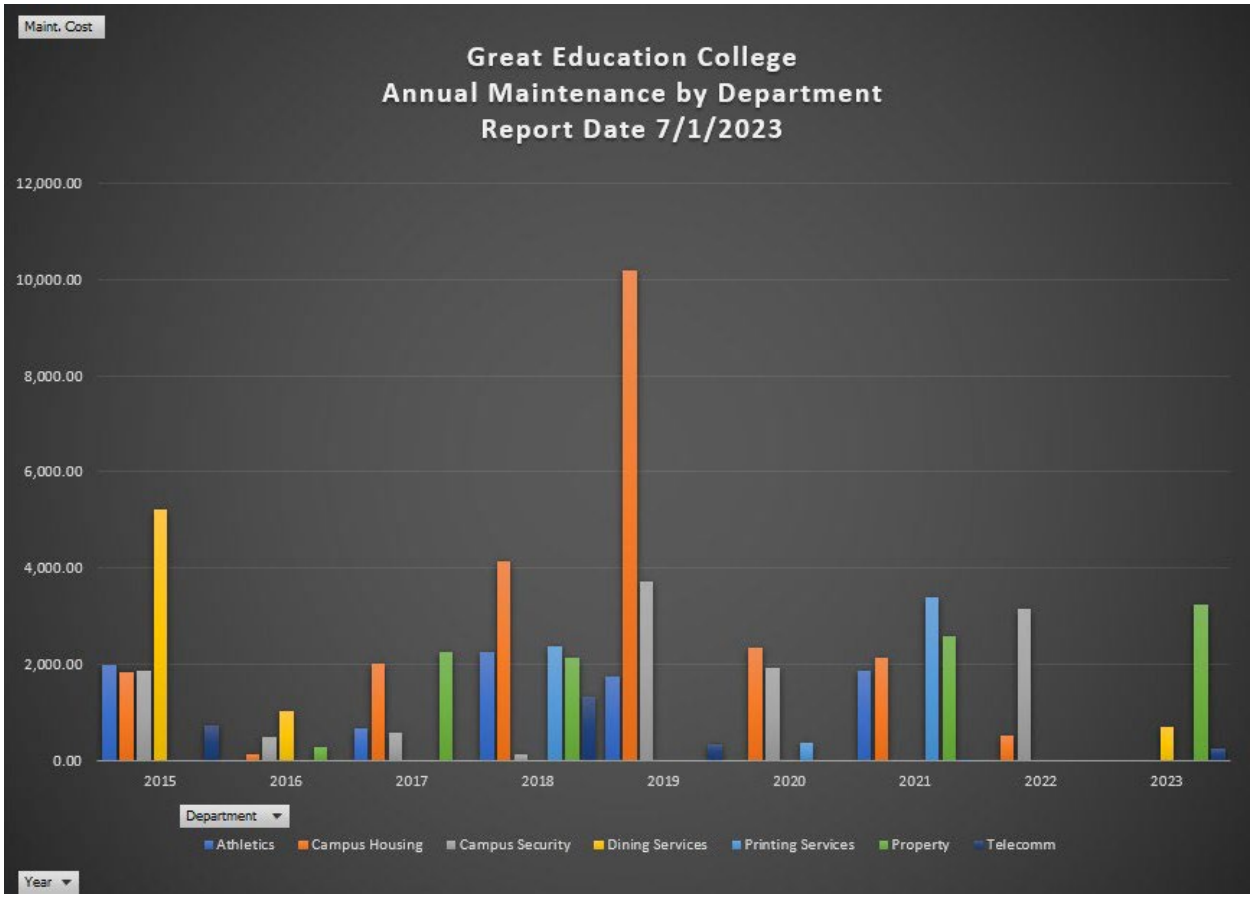
9. Close the PivotChart field list.
10. From the Design tab of the PivotChart Tools, apply Style 8 to the PivotChart.
11. From the Quick Layout button select Layout 3 which will put the legend below the chart and insert a Title.
12. Click in the title box. In the Formula bar insert the same title you used for the PivotTable.

Great Education College
Annual Maintenance by Department
Report Date 7/1/2023

13. From the Add Chart Element button, add a primary vertical axis.
14. Click in the vertical axis. In the formula bar type: Annual Maintenance Cost

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 5.27: Completed PivotChart.



Integrity Check – Pivot Chart
Your PivotChart is dynamically linked to your PivotTable. This means that any changes you make in your PivotTable will change your PivotChart.

Excel for Mac - Pivot Charts
Select a cell in the pivot table and then go to recommended charts. From there, chose a chart type and it will create a pivot chart.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Chapter Assignments and Tests.

To assess your understanding of the material covered in the chapter, please complete the following assignments.

Tables Skill Review Part A

Beach Front Gift Shop (Comprehensive Review) Starter File: Chapter 5 CiP Exercise 1

Difficulty: Level 1

Beth owns The Beach Front Gift Shop along the Oregon coast that sells jewelry, gifts, baked goods and hot drinks. She entered her store sales data for August and she wants you to sort and filter the data, as well as create summary reports using the Subtotal command.

1. Rename the worksheet Raw Data.
2. Freeze the top row so the headers remain on the screen as you scroll.
3. Make a copy of the Raw Data worksheet and then rename the worksheet Aug Data. (*Hint:* To make a copy of the worksheet, press and hold the CTRL key as you drag the sheet tab to the right of the Raw Data sheet tab.)
4. In the Aug Data worksheet, unfreeze the top row.
5. Create an Excel table for the cash receipts data and name the table AugData.
6. Format the table with Table Style None.
7. Format the amount column with comma, and two decimal places.
8. Make the following changes to the AugData table:
    a) Add a record for Aug 31, Saturday, 35, Hot Drinks, 153.11
    b) Edit the record on 8/28/2024 for Hot Drinks by changing the amountfrom 193.62 to 198.71.
    c) Delete any duplicate records.
9. Insert a row so that there is a blank row between your title and the table data. (Row 2 should be a blank row.)Insert your title in A1, merged and centered, above the data table and insert the following: The Beach Front Gift Shop
   Sales Receipts
   August, 2024
   Resize row to show the title.
10. Make a copy of the Aug Data worksheet and rename the copied worksheet Sort Trn Date. Change Table name to SortTrnDate.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

11. Do a multi-level sort by Trn Date, newest to oldest, and then by Amount, largest to smallest.
12. Change the second line of your worksheet title to read Sales Sorted by Date and Amount.
13. Make another copy of the Aug Data worksheet and drag it to the right of the SortTrn Date worksheet. Rename the copied worksheet Sort by Day. In the Sort by Day worksheet, sort the cash receipts by Day (use the custom list order of Sunday, Monday, …), then by Department (A to Z), and then by Amount (largest to smallest).
14. Change the second line of your worksheet title to read "Sales Sorted by Day of the Week and Department".
15. Make another copy of the Aug Data worksheet and drag it to the right of the Sort by Day worksheet. Rename the copied worksheet Filter Omit Jewelry. In the Filter Omit Jewelry worksheet, filter the data to display all the receipts for all items except Jewelry and sort by amount. Rename the table Jewelry Omitted.
16. Insert the Total row to calculate the average amount of the cash receipts for the filtered data. Change the label on the Total row to Average Daily Sales. Sort the filtered data in descending order by Amount.
17. Change the second line of your title to "Sales Receipts Sorted by Amount, Jewelry Omitted".
18. Make a copy of the Aug Data worksheet placed to the right of the Filter OmitJewelry worksheet and rename the new worksheet Filter by Day.
19. In the Filter by Day worksheet, insert a slicer for the Day column. Move the slicer so the upper left corner sits at G2. Change the slicer's width to 1.2" and its height to 2.5". Use the slicer to display cash receipts for Saturday and Sunday. Add a total row and format for $ with Top and Double Bottom border.
20. Change the second line of the title to read "Saturday and Sunday Sales Receipts".
21. Make a copy of the Aug Data worksheet and place it to the right of the Filter byDay worksheet. Rename the worksheet Subtotals.
22. Convert the table to a range.
23. Sort by Department and then by Day ,(Remember to use the custom list for the days Order).
24. Add Subtotals from the Data ribbon to subtotal sales first by Department, then by Day.
25. Change the title on the Subtotal worksheet to reflect the subtotals.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Tables/Pivot Tables Skills Review Part B

Beach Front Gift Shop (Comprehensive Review)

Starter File: Continue with your Chapter 5 CiP Exercise 1 file.

Difficulty: Level 2

This exercise continues with where you left off from Careers in Practice Exercise

1. Based on the data in the Aug Data worksheet, create a PivotTable in a new worksheet that shows the total sales receipts by Day. Format the grand total with currency format. (hint: Use the format icon from the Home ribbon - not value field settings.) Rename the worksheet with the PivotTable as PivotTable by Day.
2. In the PivotTable by Day worksheet, insert a Clustered Column PivotChart based on the PivotTable you created. Move the PivotChart to row 3 to the right of the PivotTable. Remove the legend, and then change the PivotChart title to Receipts by Day of the Week. Resize title so all the rows are visible.
3. Based on the data in the Aug Data worksheet, create a PivotTable in a new worksheet that shows cash receipts by Trn Date. Add the Department field to the Columns area. Format the Amount field with Accounting format with two decimal places. Rename the worksheet PivotTable by Trn Date.
4. In the PivotTable by Trn Date worksheet, insert a slicer for the Department field of the PivotTable. Change the slicer height to 1.6" and the width to 1.4". Use the slicer to filter the PivotTable by Trn Date to display only the Hot Drinks and Baked items amounts.
5. Create a title merged and centered over the pivotable and pivot chart. Middle row of the title should read Receipts by Day of the Week.
6. Based on the data in the Aug Data worksheet, insert the Recommended PivotTable Sum of Amount by Week # and Department PivotTable. Rename the worksheet as Recommended PivotTable. (The week number is the week number the date falls in for the year.)
7. All of your PivotTables should have titles that describe the data being presented. Your column headers should also be changed to describe data presented. All PivotTable and PivotChart data should be professionally formatted.
8. Save your file.

Careers in Practice 3

Lane Community College

Start File: Chapter_5_Exercise_3.xlsx

Difficulty Level: 2

Lane Community College: Mary Jackson is an assistant dean at LCC. She uses Excel daily for a variety of tasks, including tracking student internships and alumni. For this project, Mary wants you to create an Excel table from information about current students and then analyze this data. Complete the following:

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

1. Create an Excel table. Format the table with style None. Change the GPA data to number format showing two decimal places, and then change the Scholarships data to the Accounting format showing no decimal places. Rename the table StuData. Resize columns to fit.
2. Name the worksheet LCC Data
3. Make a copy of the LCC Data worksheet, and then rename the copied worksheet as **Sort by Major**.
4. Sort the data in ascending order by Major, and in in descending order by GPA.
5. Filter data to remove all undecided majors.
6. Insert a Total row that shows the number of students in the Last name column and the average GPA in the GPA column. Change the Total row label to Average and remove the entry in the Class column of the Total Row.
7. Make a copy of the LCC Data worksheet and rename the worksheet **Filter by Class**. Filter the data to display only those students who have a GPA greater than 3.00.
8. Further filter the data to display only Juniors and Seniors.
9. Sort the filter data in ascending order by Class and then in descending order by GPA.
10. Make a copy of the LCC Data worksheet, and the rename the copied worksheet as **Subtotals**. Convert the table to a range. Sort by Major. Use the Subtotal command to display the Average GPA for each Major in the GPA column.
11. Use the Subtotal command to show the total $ amount of scholarships by Major.
12. Make sure each worksheet has appropriate titles.

Careers in Practice 4

Pacific NW Sales: PivotTable and PivotChart Assignment

Starter File: Chapter_5_CiP_PacificNW.xlsx.

Difficulty Level: Intermediate

Sue, from Pacific NW Outfitters, received some additional data from her distributor that she needs to analyze and give to the marketing group. The data was stored in an Access database. The data includes the company name, address, phone number, first order date, and last order date for each retailer located in the Pacific Northwest. There is a field that identifies the total number of orders placed by each retailer for the company's products. The distributor's database also includes total sales by month, from January 2023-March 2024.

Complete the following:

1. Make the following changes to the worksheet:
    a. Convert the table to a range.
    b. Center and bold column headers
    c. If necessary, adjust the column width to accommodate the data.
    d. Name the worksheet Pacific NW Region

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

2. Calculate the total sales since January 2023 for each company in a column named TotalSales.
3. In cell AC1 enter the report date of 2/28/2024 and name the cell ReportDate.
4. In column Y, calculate the number of days since each company has placed an order in a column named DaysLastOrder. Format the values as a number with zero decimal places.
5. Calculate the number of fractional years that each company has been ordering from the company in a column named relationship years. (Hint: Use the function YEARFRAC and the firstorderdate and lastorderdate format for comma, with one decimal place.
6. Create a PivotTable report from the data in the Pacific NW Region worksheet into a sheet called PivotTable Report.
7. Add the TotalSales field to the Values area and format as currency.
8. Add the DaysLastOrder field to the Rows area. After adding the field to the PivotTable report, group records in this field into groups of 100, starting with the value 0.
9. Add the StateProv Field to the Columns area and then add the Company Namefield below the Values area to count the number of companies in each state. Add the TotalSales field in the Values area.
10. Use the Value Field Settings dialog box to customize the field names in the PivotTable report as Total Sales and Number of Companies.
11. Insert a slicer for StateProv and place it under the PivotTable.
12. Insert a 3-line title over the table.
13. Go back to the Pacific Region worksheet and create a second PivotTable.
    a. Put the LastOrderDate in the Rows area and expand to show by month. (Hint: hit the + in each of the years, Qtr., to expand the data.)
    b. Add CompanyName to the Filters area.
    c. Add Total Sales to the values area.
    d. Add NumberofOrders below the TotalSales in the values area.
    e. Change the worksheet name to PivotTable 2
14. Add a Timeline for LastOrder Date and place it below the PivotTable.
15. Format and title the PivotTable appropriately.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

16. Create a PivotChart from the PivotTable. Use a Combo chart, clustered column with line. Under Chart type for TotalSales select Clustered Column. Under Chart type for NumberofOrders select Line with markers. Then check the box for Secondary Axis on the NumberofOrders Series.
17. Move the chart to its own chart sheet called PivotChart. Give titles to the secondary vertical and horizontal axis.
18. Format the vertical Y axis values to no decimal places.
19. Create a chart title that gives the company name and describes what data the chart is displaying.
20. Verify that all of your PivotTables have titles.
21. Save your file with your name.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Chapter 6

Dynamic Array Functions and Solver

Dynamic Array Functions

LEARNING OBJECTIVES
1. Use the SEQUENCE function to generate a list of numbers. 2. Use the UNIQUE function to obtain a list of unique items from a large list containing multiples of those items. 3. Use a SORT function in a dynamic array so that the data is always sorted. 4. Use a UNIQUE function in a data validation list. 5. Add records to the table. 6. Create a dynamic FILTER function to filter data. 7. Use a SORTBY function to obtain multiple sort levels.

In Chapter 2.2 the concept of dynamic arrays was introduced. This new functionality was introduced in Excel 365 and is not available in legacy versions of Excel. In this chapter we will explore some of the new functions available. These functions are intended to replace the older legacy array functions and should be used in all new work.

Some of the advantages to using dynamic array functions are:

- They automatically resize when new data is added or deleted.
- Columns and rows can be inserted or deleted within a dynamic array.

Some of the disadvantages are:

- Backward compatibility to legacy Excel users.
- #SPILL errors

6.1 SEQUENCE

The SEQUENCE function in Excel will generate a list of sequential numbers in an array format. It is helpful when dealing with many rows or columns that need sequential numbers or dates. It can also generate numbers in incremental values and from high to low. This function is available in Excel for Microsoft 365, Excel 2021, and Excel for the web. Legacy versions of Excel do not have this functionality.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

The syntax of the SEQUENCE function is:

=SEQUENCE(rows, [columns], [start], [step]) where:

- **rows**: **Required**. The number of rows to return. This is the only required argument. The others are optional based on the results needed.
- **columns**: Optional. The number of columns to return. Defaults to 1 if omitted.
- **start**: Optional. The first number in the sequence. Defaults to 1 if omitted.
- **step**: Optional. The increment for each subsequent value. Defaults to 1 if omitted.

Examples of Using SEQUENCE

Example Formula	Description	Result
=SEQUENCE(5)	Generates 5 rows of sequential numbers starting at 1.	{1; 2; 3; 4; 5}
=SEQUENCE(1, 5)	Generates 1 row of 5 sequential numbers.	{1, 2, 3, 4, 5}
=SEQUENCE(5, 5)	Creates a 5x5 array of numbers from 1 to 25.	{1, 2, 3, 4, 5; ...}
=SEQUENCE(3, 1, 10, 5)	Generates 3 rows starting at 10, incrementing by 5.	{10; 15; 20}
=SEQUENCE(6, 1,-10, 2)	Generates a descending sequence from -10 to 0.	{-10; -8; -6; -4; -2; 0}

Generating Dates

The SEQUENCE function can be used to create a series of dates. For example:
To generate 10 consecutive days starting from today:
=SEQUENCE(1, 10, TODAY(), 1)
This will return a horizontal array of dates starting from today.

Important Notes

The output from the SEQUENCE function will "spill" into adjacent cells, so ensure there is enough space.
If the function is used in older versions of Excel (like 2019 or earlier), it will not work as these versions do not support dynamic arrays.

6.2 UNIQUE

There are times when a large data set needs to be condensed down into unique components. This could be because the list will be used in a data validation or some other function where the unique components must be identified. This data can be easily extracted using the UNIQUE function.

The UNIQUE function is one of the six new dynamic array functions introduced in Excel 365 in 2020.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Follow-along file: Excel Objective 6.0

The data contained in this workbook catalogs the vehicles owned by Oregon State University. It shows the Asset ID number, the year of the vehicle, the make, model, mileage, department the vehicle is assigned to, purchase price, and annual maintenance cost. We will use structured table references (introduced in Chapter 5) in the creation of these functions.

The goal in using the UNIQUE function in this worksheet is to be able to create a dynamic drop-down list that will update whenever a new category type is added to the database.

The syntax of the UNIQUE function is:

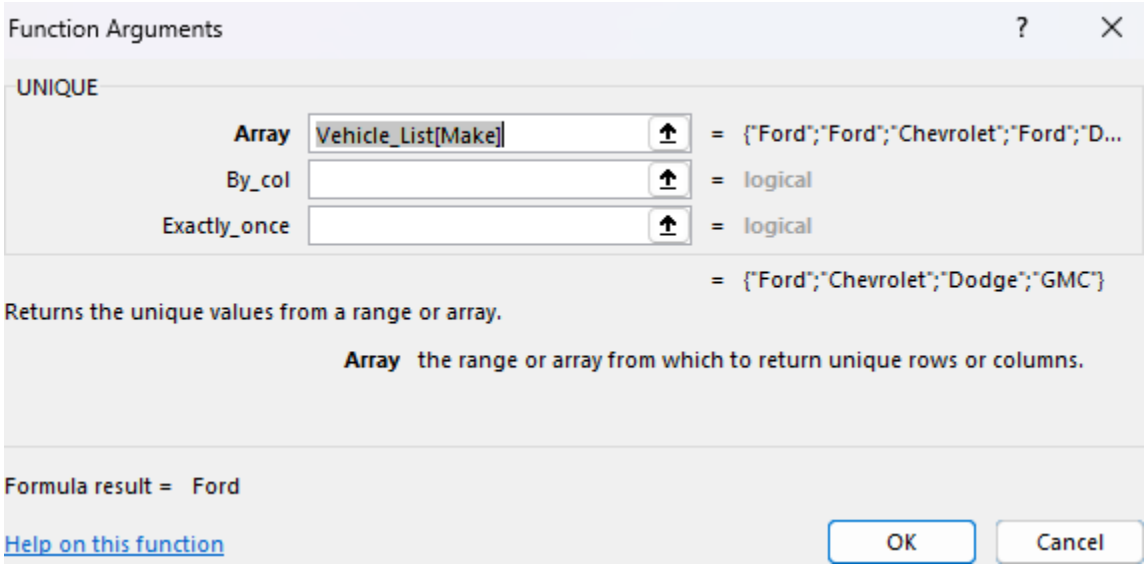
=UNIQUE(**Array**,By_col,Exacty_once)

- Array: This argument is the only required argument and defines the range from which to return unique rows or columns.
- By_col: return unique rows: FALSE (the default if left blank), return unique columns: TRUE.
- Exactly_once: the default is TRUE to only return one unique value. FALSE returns all unique rows or columns.

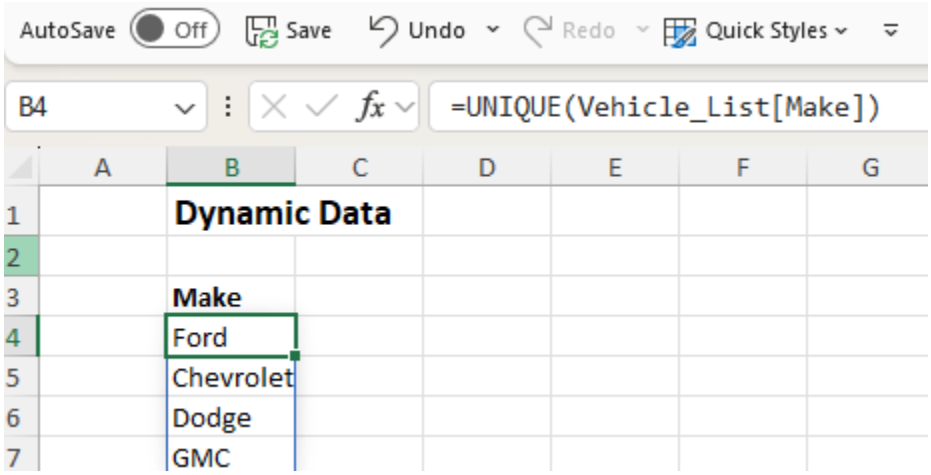
The steps we will use to accomplish this are:

1. Open Excel Objective 6.0
2. Click anywhere in the data and convert the raw data to a table with table style none. Name the table Vehicle_List.
3. Create a new worksheet and name it Dynamic Data.
4. Type Dynamic Data into cell B1.Bold the text and increase font size to 14.
5. In cell B3, type Make. Bold the text.
6. Click in cell B4. Go to the Formulas ribbon > Formulas > Function Library > Lookup & Reference > Unique.
   The UNIQUE function dialog box will open.
7. We will use a structured reference to create the UNIQUE function. In the Array box type in the table name Vehicle_List[Make].
8. You will not use any of the other arguments for this exercise, so click on OK.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International



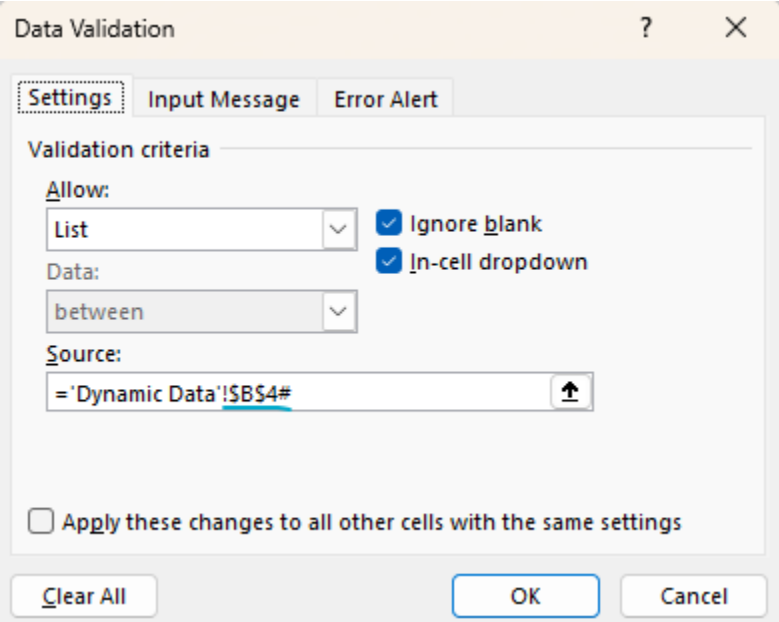
The unique list is created spilling from B4.



9. Let's add a new vehicle make into our data set. Return to the College Vehicles worksheet. In row 75 enter the following information:
    a. Asset No: 2590
    b. Year: 2025
    c. Make: Toyota
    d. Style: Truck
    e. Miles: 100
    f. Department: Athletics
    g. Purchase price: 41,250
    h. Annual Maintenance: 1,525

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

10. Go back to the Dynamic Data worksheet. Notice that Toyota was automatically added to the unique list.
11. It gets even better. Let's add a data validation list to the College Vehicles worksheet. In cell J2 type in Data Validation List.
12. In K2, from the Data ribbon, select Data Validation. Choose List type. In the Source box type =, then go to the Dynamic Data worksheet and click on cell B4. Add a hash tag # at the end of the cell reference. See below:



13. This dynamic list will automatically update whenever a new model is added to the source data. An exciting feature that can save tons of work and give peace of mind in your worksheet's ability to adapt to new information.

Skill Refresher -UNIQUE

12. Type an equal sign (=).
13. Type the function name UNIQUE followed by an open parenthesis (().
14. If necessary, define the way the function will filter argument – either by row or by column. The default is row
15. Type a closing parenthesis).
16. Press the ENTER key on your keyboard

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

6.3 SORT

Follow-along file: Excel Objective 6.01

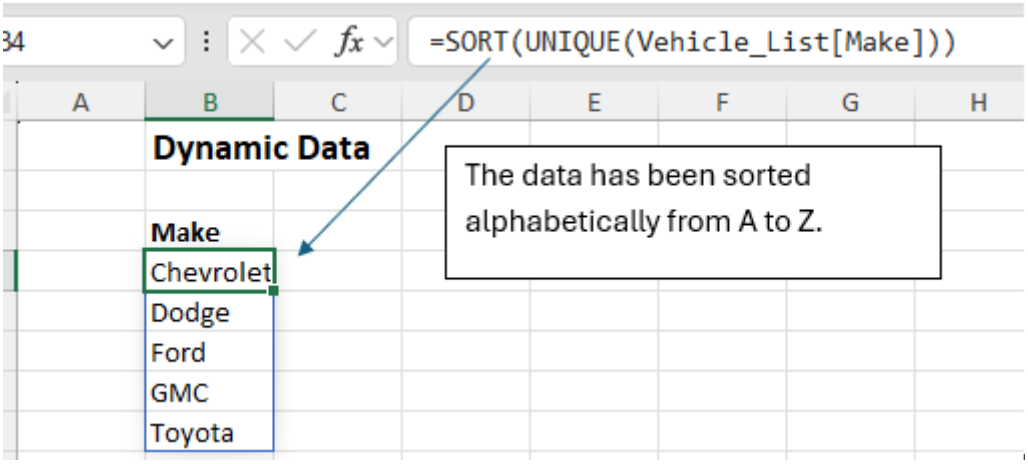
Using the UNIQUE function returned a range of unique values, but it displayed them in the order it found them in the data. If you are dealing with large unique identifiers, it can be difficult to find what you want in the list. It would be much easier to sort the list so that the identifiers could be found in ascending or descending order. To accomplish this we will nest the UNIQUE function in a SORT function. Before we proceed, take another look at the data validation list on the College Vehicles worksheet. Note that the makes are not in alphabetical order.

The SORT function is made up of the following arguments:

=SORT(**Array**, Sort_Index,Sort_order,By_col)

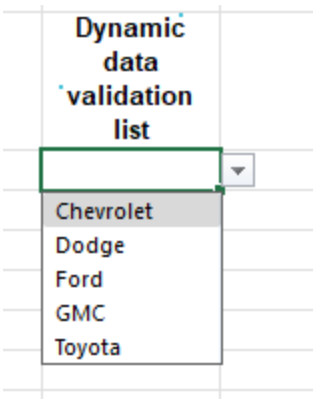
- Array: the range you want to sort. It is the only required argument in the SORT function.
- Sort_Index: in a multiple column or row array, this would indicate the column or row to sort on.
- Sort_Order: 1 for ascending sort, -1 for descending sort.
- By_col: FALSE is the default and sorts by row. TRUE will sort by colum.

The SORT will be done on the Dynamic Data worksheet. Click in cell B4. Go to the formula bar and click between the = and the UNIQUE function name. Type SORT(. Go to the end of the UNIQUE function and close the SORT function with a closing parenthesis).



Return to the College Vehicles worksheet and examine the data validation list in J4. The data validation list is also sorted alphabetically because the data is dynamically linked.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International



The default sort order is A to Z. To sort from Z to A you would include a **-1** in the third argument of the function

Skill Refresher -SORT
1. Place your cursor in between the equal sign (=) and the UNIQUE. 2. Type the function name SORT followed by an open parenthesis ((). 3. Close the function after the closing parenthesis of the UNIQUE function 4. Press the ENTER key on your keyboard

6.4 FILTER

Follow-along file: Excel Objective 6.02

The FILTER function provides the ability to extract a filtered range of values from a table or range. It is a simple function with powerful results. While you can use a range of data for the FILTER, it is recommended that the raw data be converted to a table so that the data set will dynamically change if new data is added or data is deleted.

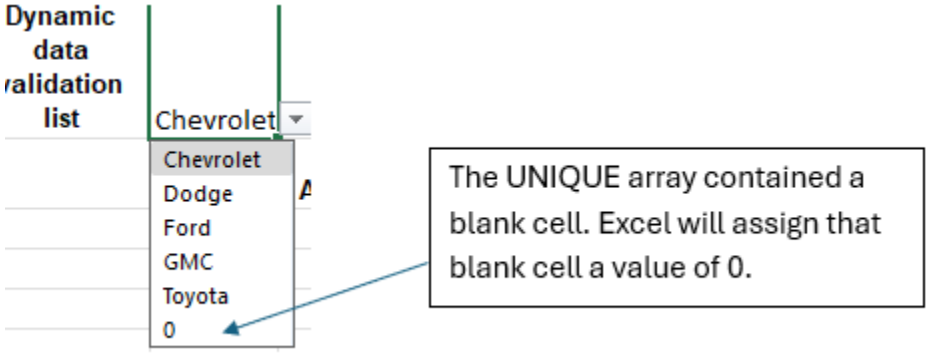
We will use the FILTER in two different ways:

- Removing a 0 value from a drop-down list.
- Extract a filtered range of values from a table or range.

Filtering a Drop-Down List:

Sometimes, your data validation list might return a value of 0 in the list components. This happens when a value from your UNIQUE data range contains a blank cell. As an example, on the delete the value in C10. Reexamine the data validation list again. A 0 appears in the list because the array now contains a blank cell. Excel will treat a blank cell in an array as a 0 value.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International



The syntax for the FILTER function is:

=FILTER(**Array,Include**,if_empty)

Where:

- Array is the data to be filtered. (required).
- Include: what the filter should include (required).
- If_empty. Text can be used to give a message if the Filter finds no data.

To remove the blank space from the drop-down created in Section 6.2, you will:

1. Go to the Dynamic Data worksheet.
2. Click in cell B4. The current formula is =SORT(UNIQUE(Vehicle_List[Make])).
3. Enclose the original SORT(UNIQUE) function with the FILTER as shown below.

   =FILTER(SORT(UNIQUE(Vehicle_List[Make])),

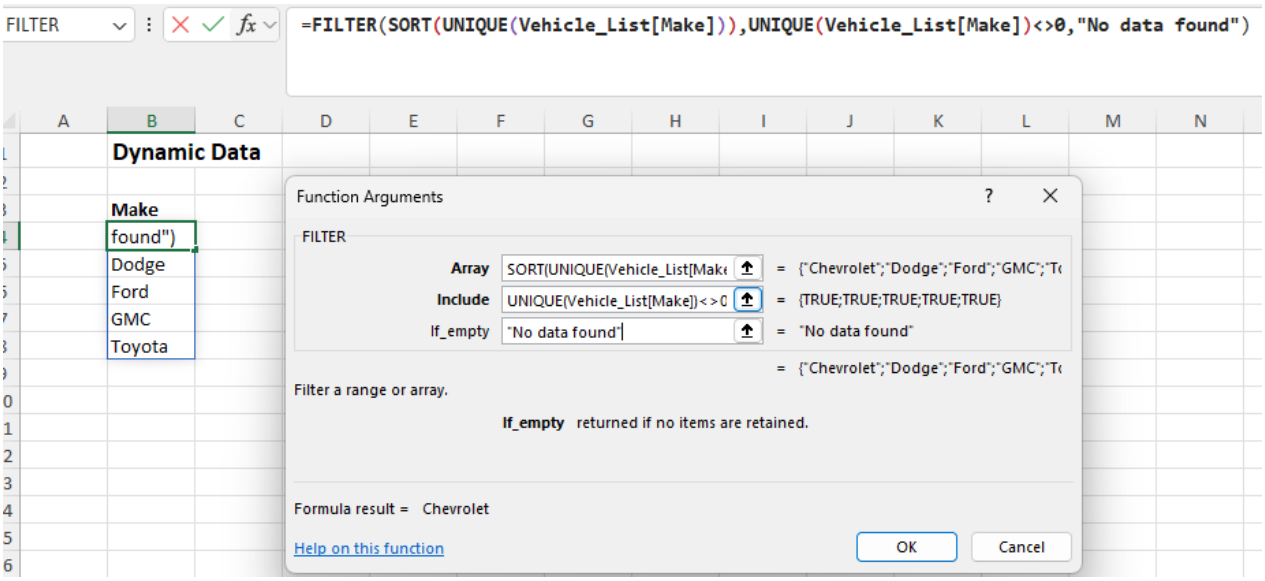
   SORT(UNIQUE(Vehicle_List[Make]**<>0**),

   "No data found")

The SORT(UNIQUE(Vehicle_List[Make]) not equal (<>) 0 is used as the second argument in the FILTER to eliminate any 0 values from the list.

The "No Data Found" as the final argument will let the reader know that no data matches the criteria of the filter.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International



Create a Filtered Data Set :

There may be times when you want to filter data from one worksheet to another, or even into a different workbook. In those cases, you would either have to copy the data set into the new worksheet or workbook and then apply the Filter function found on the Data ribbon. The problem arises when the original data changes, grows or contracts with new or deleted data. The copied data will not grow or contract with the changed data. It will remain the same as the original. In the case where you want your data to be dynamic and adapt to changes in the data set, you will want to use the FILTER function linked to the original data.

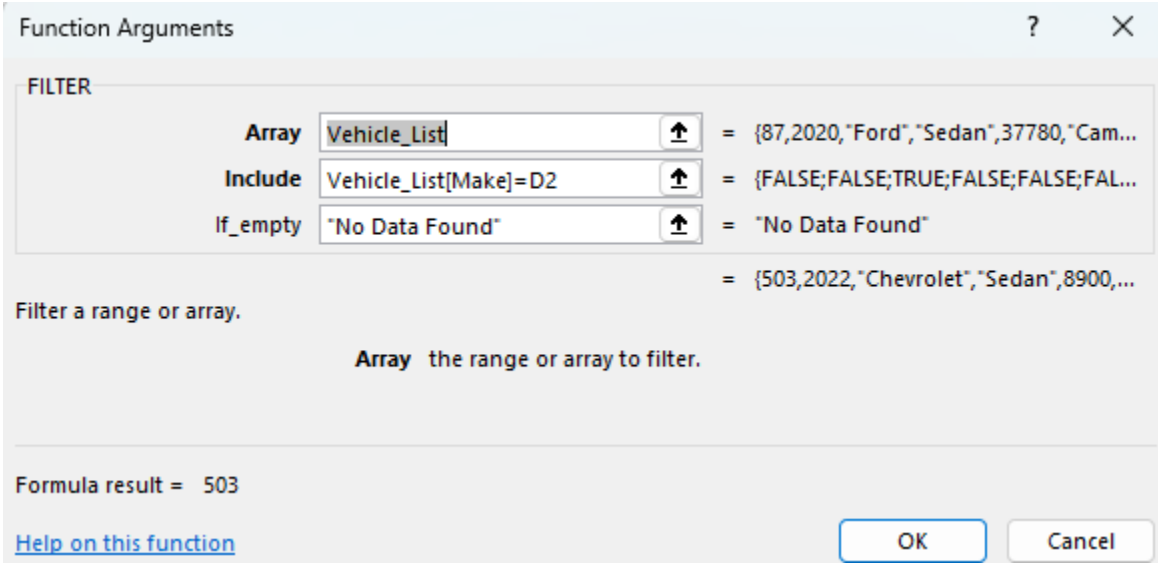
We will use this function to create a dynamic filtered list on a new worksheet.

1. Insert a new worksheet and name it Filtered Data.
2. Merge across cells A2:C2 and type “College Vehicle Make:”
3. In cell D2 create a data validation list using the UNIQUE list from the Dynamic List worksheet.
4. From the College Vehicles worksheet, copy the column headers in cells A3:H3 and paste them into the Filter Data worksheet starting at B4.
5. In cell B5 we will put the FILTER function to display all of the data from whichever car make is selected in D2. This is a dynamic function. The data it returns will expand and contract based on the original source data changes.
    a. ARRAY: the table named Vehicle_List.
    b. Include: the vehicle selected in D2: Vehicle_List[Make]=D2
    c. If_empty: “No data found’.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

=FILTER(Vehicle_List,Vehicle_List[Make]=D2,"No Data Found")

6. Hit Enter or OK if using the Insert Function dialog box.



The filtered list will dynamically populate starting in B5. If you click on any other cell in the dynamic list, the function will be visible but be grayed out. Format the odometer, purchase price maintenance columns appropriately. (Note: formatting applied will not expand if a different make is selected. Suggestion: format as many rows as you think possible so that, no matter how the data expands and contracts, the appropriate formatting will be applied.

Skill Refresher -FILTER
17. Type an equal sign (=). 18. Type the function name FILTER followed by an open parenthesis ((). 19. Select the array to be filtered. 20. Include an If_empty argument to give information if no data is found. 21. Type a closing parenthesis). 22. Press the ENTER key on your keyboard

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Solver

Companies set goals using research that analyzes the choices or options that identify the decision they need to make and the best potential outcomes. The method used to narrow the available options for a problem to choose the best potential outcome is an analytical process known as **optimization.** Companies must answer the following questions before using optimization to solve a problem:

- How many resources are available?
- How many resources are needed?
- How many resources does each decision variable consume?
- How much does each decision variable contribute to the objective?

For example, consider the problem that a baker might have. Which products and how many of each should the baker prepare for the next day's sales? The baker's primary goal might be to maximize revenue. The decision variables in this case are how many of each product to prepare. Some products will generate more revenue than others but might use more resources. Each product will require a different number and amount of resources to produce. The resources in this example include ingredients, labor, and baking time. Each product contributes to the goal of increasing the baker's revenue, but there is an optimal combination of products that the baker can prepare to use the available resources and generate the maximum amount of revenue.

Excel includes a tool called **Solver** that uses techniques from operations research, a field focused on optimizing decisions, to solve all kinds of problems.

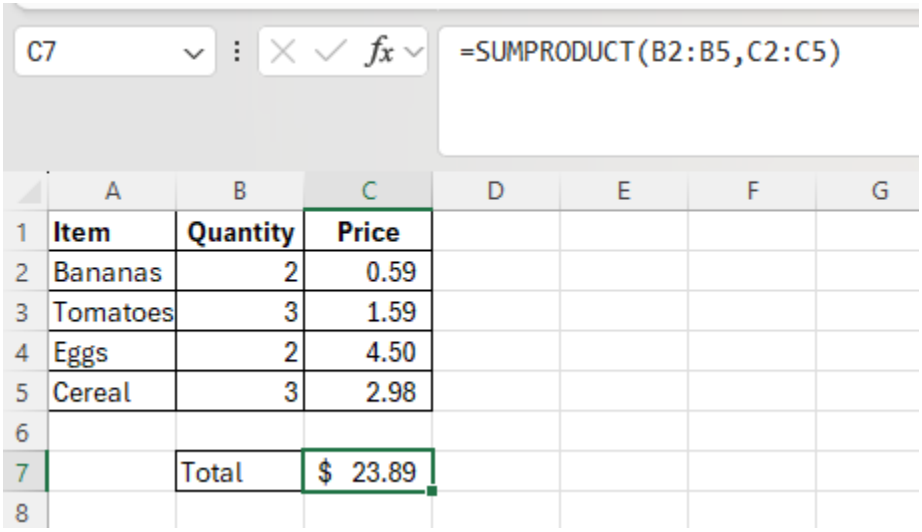
LEARNING OBJECTIVES
1. SUMPRODUCT function explored. 2. Load Solver add in. 3. Formulate the model. 4. Solve the model. 5. Answer reports.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

6.5 SUMPRODUCT

THE SUMPRODUCT function multiplies corresponding numbers in two ranges. It then adds the results together. To calculate the sum of the products of corresponding numbers in one or more ranges, use the SUMPRODUCT function.

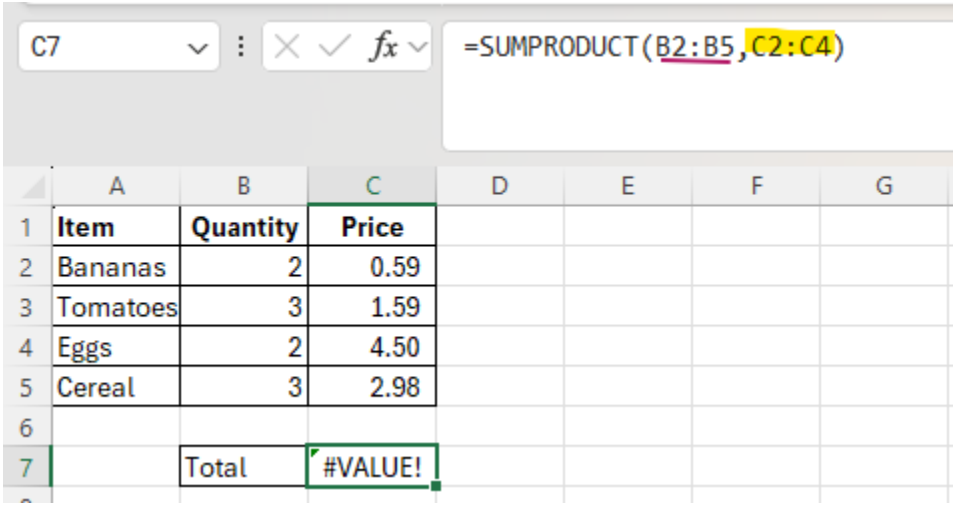
For example, the SUMPRODUCT function below calculates the total amount spent.



	A	B	C	D	E	F	G
1	**Item**	**Quantity**	**Price**				
2	Bananas	2	0.59				
3	Tomatoes	3	1.59				
4	Eggs	2	4.50				
5	Cereal	3	2.98				
6							
7		Total	$ 23.89				
8							

Explanation: the SUMPRODUCT function performs this calculation: (2 * 1000) + (4 * 250) + (4 * 100) + (2 * 50) = 3500.

The ranges must have the same number of cells in the array. In the above example there are 4 cells in the quantity column and 4 cells in the price column. If they are not the same number of cells, or the same number of cells are not selected in the function, Excel will display the #VALUE! error.



	A	B	C	D	E	F	G
1	**Item**	**Quantity**	**Price**				
2	Bananas	2	0.59				
3	Tomatoes	3	1.59				
4	Eggs	2	4.50				
5	Cereal	3	2.98				
6							
7		Total	#VALUE!				

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

The SUMPRODUCT function will treat any entries that are not numeric as if they were zeros.

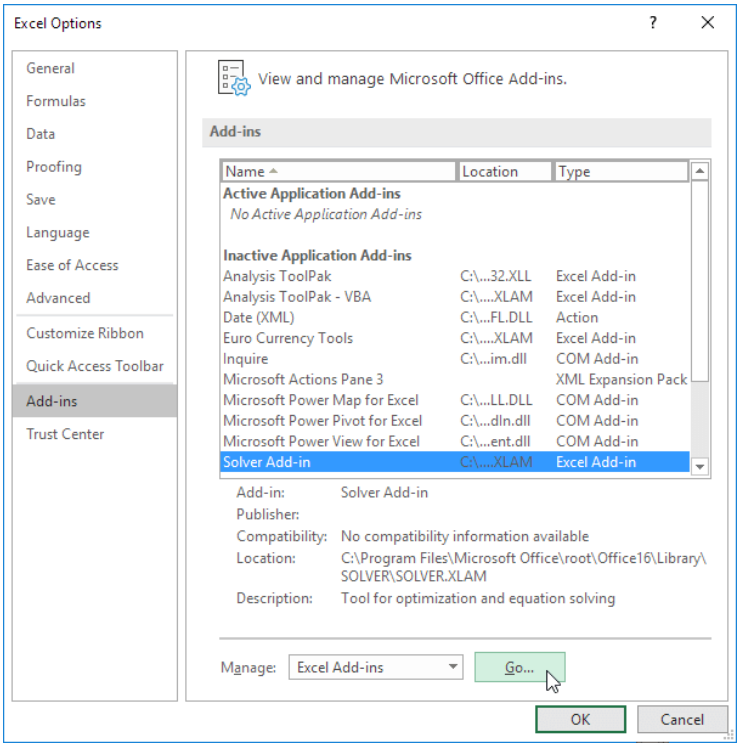
If you supply a single range, the SUMPRODUCT function produces the exact same result as the SUM function.

Key Takeaways
• SUMPRODUCT multiplies and adds multiple arrays to create a result. • SUMPRODUCT arrays must have the same number of cells in the each array within the function.

6.6 Creating the Solver Model

Load the Solver Add-in

To load the Solver add-in, execute the following steps:



1. On the File tab, click Options.

2. Under Add-ins, select Solver Add-in and click on the Go button.

3. Check Solver Add-in and click OK.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

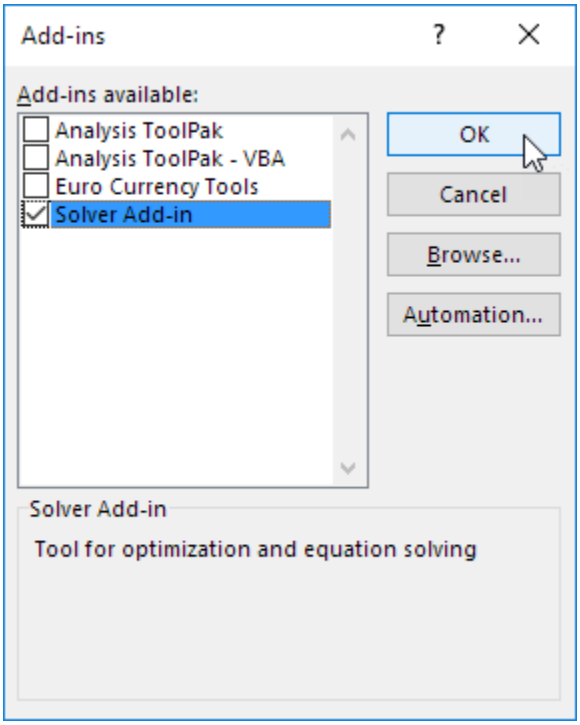


Figure 2: image of Add-ins menu

4. You can find the Solver on the Data tab, in the Analyze group.

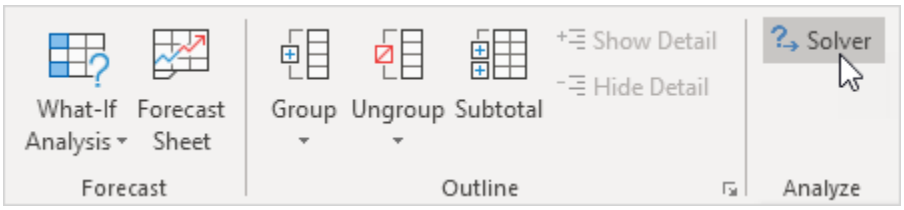


Figure 3: Image of Data Ribbon with Solver installed

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Formulate the Model

Follow-along file: Excel Objective 6.5.01

The model we are going to solve looks as follows in Excel.

	A	B	C	D	E	F	G	H	I	J
1	Bicycles International									
2										
3			Bicycles	Mopeds	Child Seats					
4		Unit Profit	100	300	50					
5							Resources		Resources	
6							Used		Available	
7		Capital	300	1200	120		0	≤	93000	
8		Storage	0.5	1	0.5		0	≤	101	
9										
10										
11			Bicycles	Mopeds	Child Seats				Total Profit	
12		Order Size	0	0	0				0	
13										

Figure 4: Image of worksheet setup

1. To formulate this linear programming model, answer the following three questions.

a. What are the decisions to be made? For this problem, we need Excel to find out how much to order of each product (bicycles, mopeds and child seats).

b. What are the constraints on these decisions? The constraints here are that the amount of capital and storage used by the products cannot exceed the limited amount of capital and storage (resources) available. For example, each bicycle uses 300 units of capital and 0.5 unit of storage.

c. What is the overall measure of performance for these decisions? The overall measure of performance is the total profit of the three products, so the objective is to maximize this quantity.

2. To make the model easier to understand, create the following named ranges.

Range Name	Range Name
UnitProfit	ResourcesAvailable
OrderSize	TotalProfit
ResourcesUsed	

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

3. Insert the following three SUMPRODUCT functions.

E	F	G	H	I	J
Child Seats					
50					
		Resources		Resources	
		Used		Available	
120		=SUMPRODUCT(C7:E7,OrderSize)	≤	93000	
0.5		=SUMPRODUCT(C8:E8,OrderSize)	≤	101	
Child Seats				Total Profit	
0				=SUMPRODUCT(UnitProfit,OrderSize)	

Figure 5: Image of functions in worksheet setup

Explanation: the amount of capital used equals the SUMPRODUCT of the range C7:E7 and OrderSize. The amount of storage used equals the SUMPRODUCT of the range C8:E8 and OrderSize. Total Profit equals the SUMPRODUCT of UnitProfit and OrderSize.

Solve the Model

To find the optimal solution, execute the following steps.

1. On the Data tab, in the Analyze group, click **Solver**.

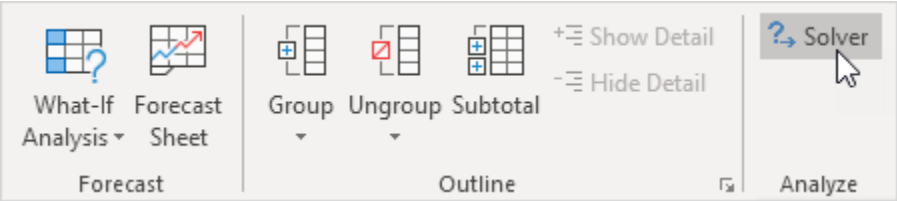


Figure 6: Image of Solver on Data Ribbon

Enter the Solver parameters one at a time. The result should be consistent with the picture below.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

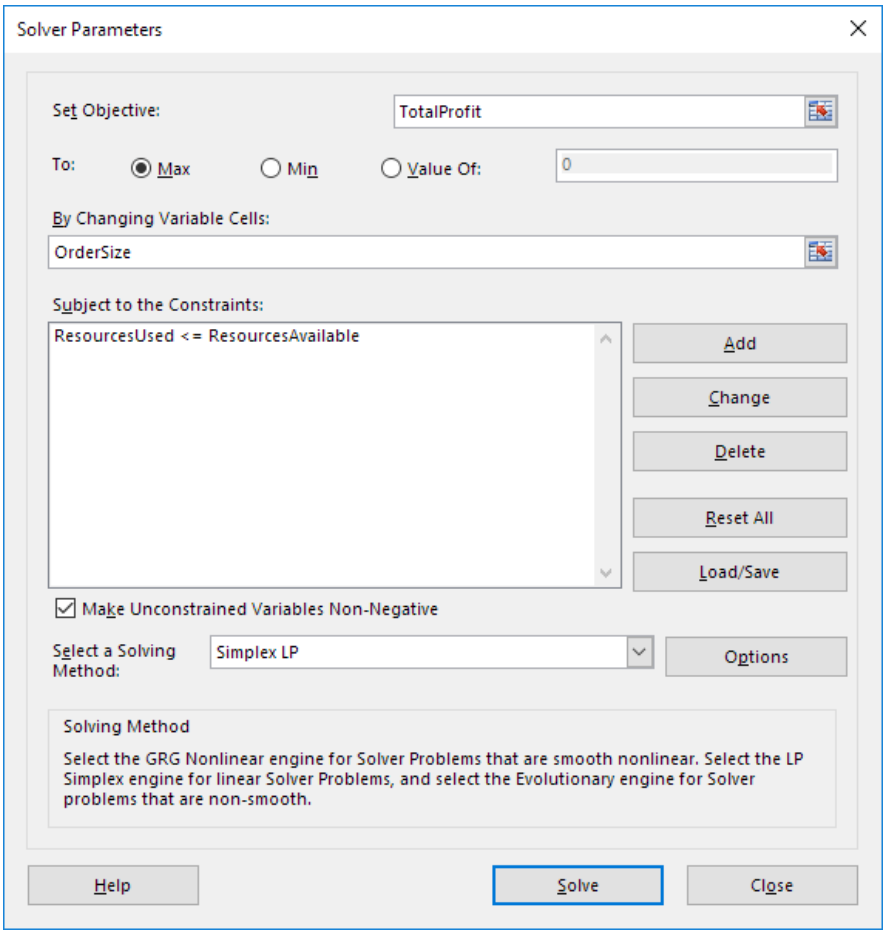


Figure 7" Image of Solver Parameters dialog box

You have the choice of typing the range names or clicking on the cells in the spreadsheet.

2. Enter TotalProfit for the Objective.

3. Click Max.

4. Enter Order Size for the Changing Variable Cells.

5. Click Add to enter the following constraint.

Figure 8: Image of Solver Constraint dialog box

6. Check 'Make Unconstrained Variables Non-Negative' and select 'Simplex LP'.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

7. Finally, click Solve.

Result:

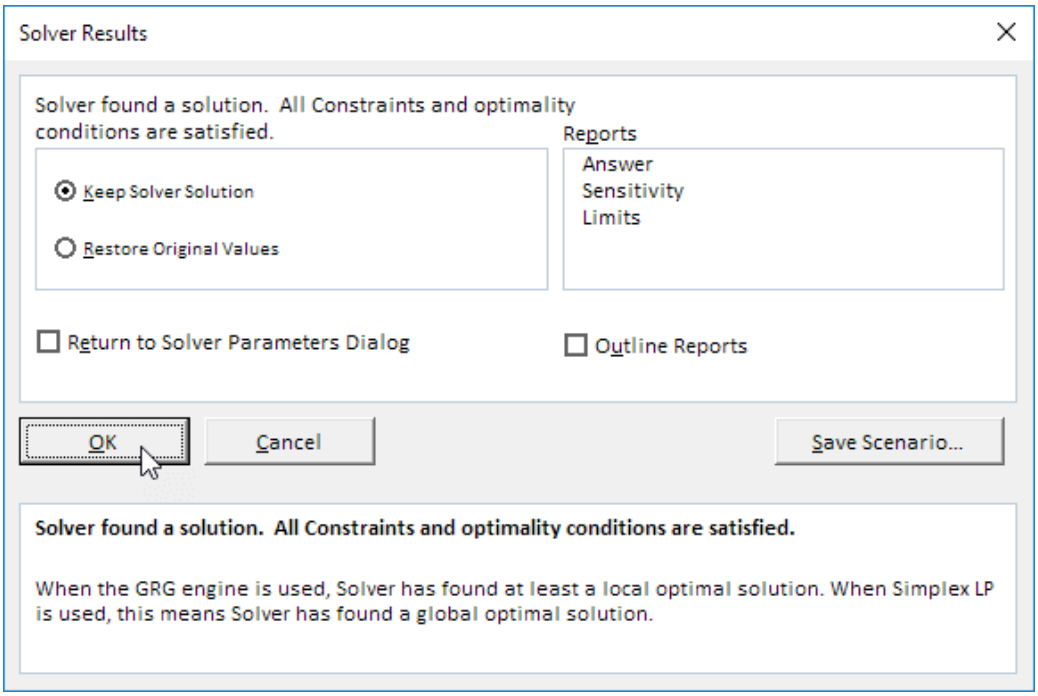

Solver Results
Solver found a solution. All Constraints and optimality conditions are satisfied.
Reports
Keep Solver Solution
Restore Original Values
Answer
Sensitivity
Limits
Return to Solver Parameters Dialog
Outline Reports
OK
Cancel
Save Scenario...
Solver found a solution. All Constraints and optimality conditions are satisfied.
When the GRG engine is used, Solver has found at least a local optimal solution. When Simplex LP is used, this means Solver has found a global optimal solution.

Figure 9: Image of Solver Results dialog box

The optimal solution:

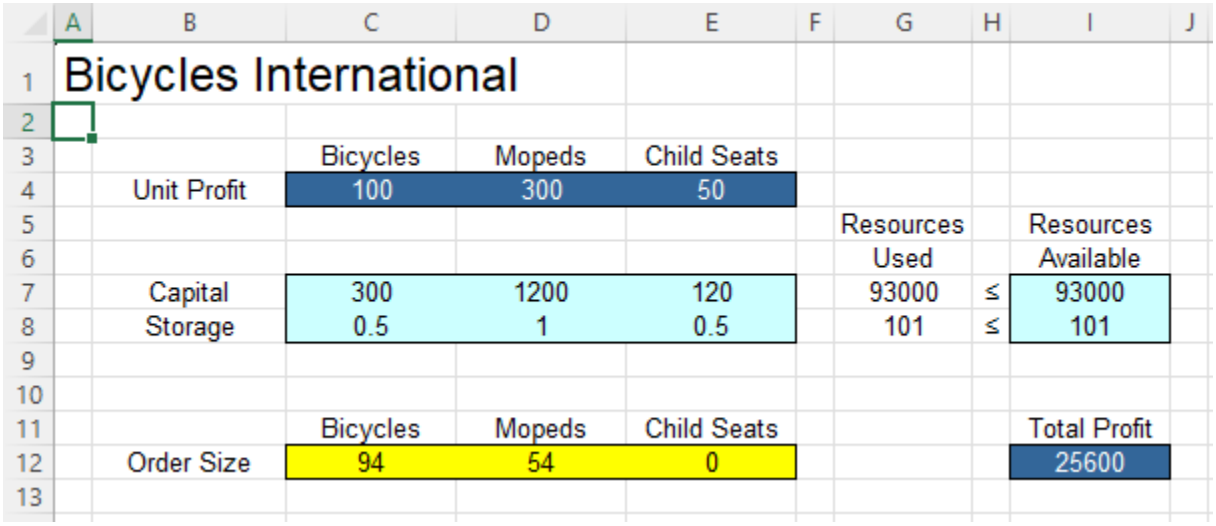


Figure 10: Image of Solver worksheet solution

Conclusion: it is optimal to order 94 bicycles and 54 mopeds. This solution gives the maximum profit of $25,600. This solution uses all the resources available. Try it yourself.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

6.7 Transportation Problem in Excel

Use the solver in **Excel** to find the number of units to ship from each factory to each customer that minimizes the total cost.

Formulate the Model

Select on the The model we are going to solve looks as follows in Excel.

	A	B	C	D	E	F	G	H	I	J
1		Transportation Problem								
2										
3		Unit Cost	Customer 1	Customer 2	Customer 3					
4		Factory 1	40	47	80					
5		Factory 2	72	36	58					
6		Factory 3	24	61	71					
7										
8										
9		Shipments	Customer 1	Customer 2	Customer 3		Total Out		Supply	
10		Factory 1	0	0	0		0	=	100	
11		Factory 2	0	0	0		0	=	200	
12		Factory 3	0	0	0		0	=	300	
13										
14		Total In	0	0	0					
15			=	=	=				Total Cost	
16		Demand	200	200	200				0	
17										

Figure 11: Image of Transportation worksheet setup

1. To formulate this **transportation problem**, answer the following three questions.

   a. What are the decisions to be made? For this problem, we need Excel to find out how many units to ship from each factory to each customer.

   b. What are the constraints on these decisions? Each factory has a fixed supply and each customer has a fixed demand.

   c. What is the overall measure of performance for these decisions? The overall measure of performance is the total cost of the shipments, so the objective is to minimize this quantity.

2. To make the model easier to understand, create the following named ranges.

Range Name	Cells
UnitCost	C4:E6
Shipments	C10:E12
TotalIIn	C14:E14

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Demand	C16:E16
TotalOut	G10:G12
Supply	I10:I12
TotalCost	I16

3. Insert the following functions.

C	D	E	F	G	H	I
Customer 1	Customer 2	Customer 3				
40	47	80				
72	36	58				
24	61	71				
Customer 1	Customer 2	Customer 3		Total Out		Supply
0	0	0		=SUM(C10:E10)	=	100
0	0	0		=SUM(C11:E11)	=	200
0	0	0		=SUM(C12:E12)	=	300
=SUM(C10:C12)	=SUM(D10:D12)	=SUM(E10:E12)				
=	=	=				Total Cost
200	200	200				=SUMPRODUCT(UnitCost,Shipments)

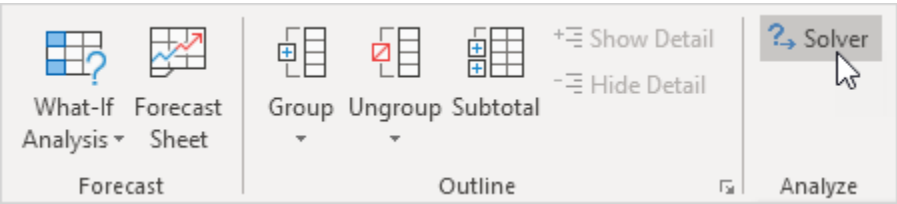
Figure 12: Image of functions in the transportation worksheet

Explanation: The SUM functions calculate the total shipped from each factory (Total Out) to each customer (Total In). Total Cost equals the SUMPRODUCT of UnitCost and Shipments.

Solve the Model

To find the optimal solution, execute the following steps.

1. On the Data tab, in the Analyze group, click Solver.



Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Enter the solver parameters. The result should be consistent with the picture below. Notice that a binary constraint has been included. The binary constraint is necessary when partial units would not be practical. For example: the shop would not ship partial bicycles but would ship a whole bicycle.

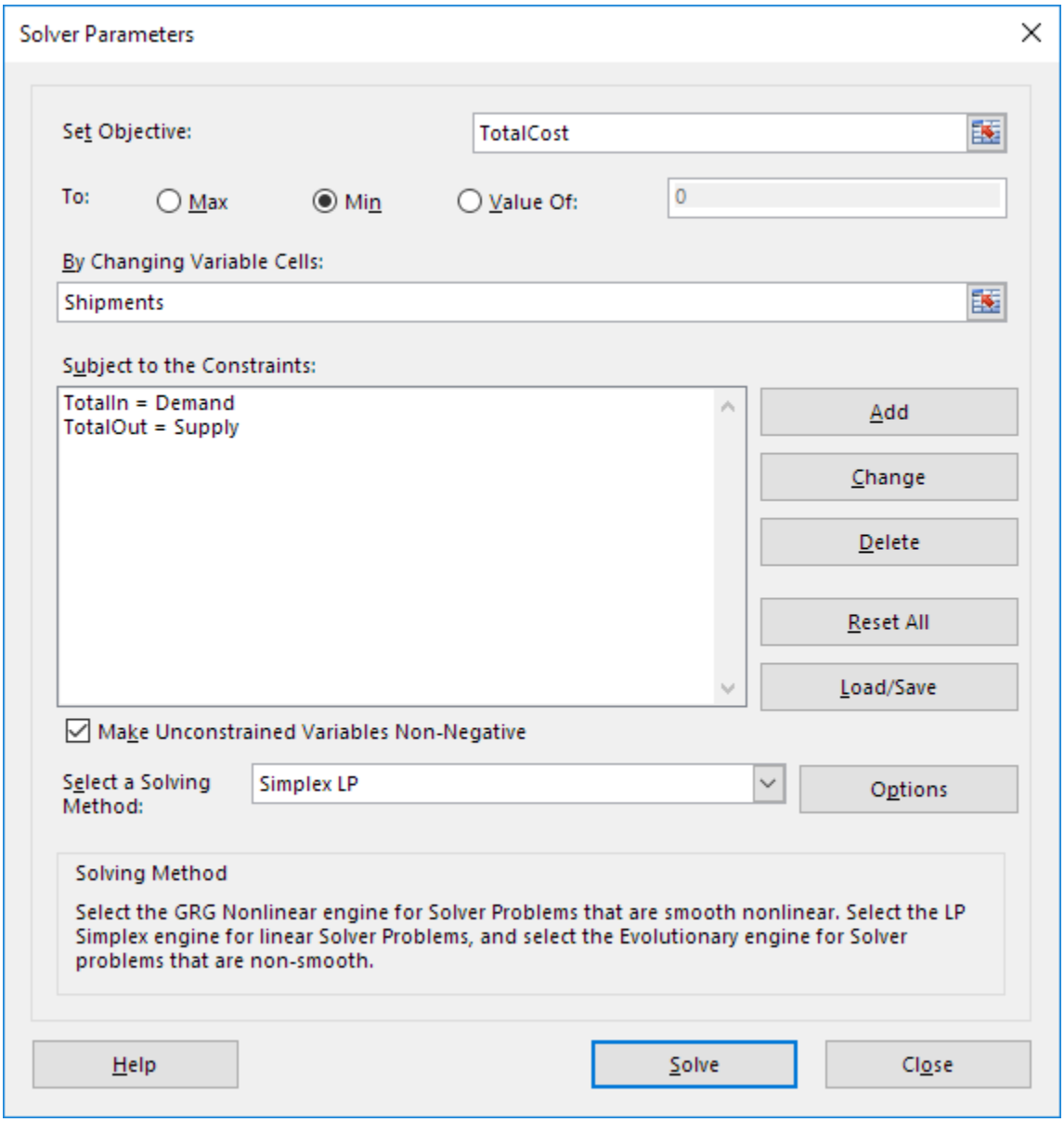


Figure 13: Image of Solver Parameters dialog box

You have the choice of typing the range names or clicking on the cells in the spreadsheet. It is highly recommended that you click on the cells in the spreadsheet to avoid misspellings that would break your solver model.

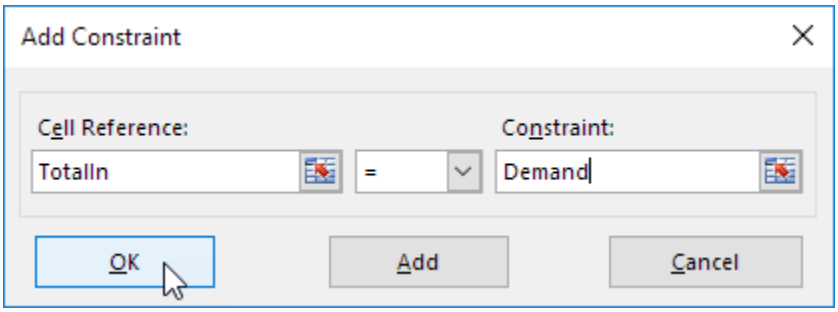
2. Enter TotalCost for the Objective.

3. Click Min.

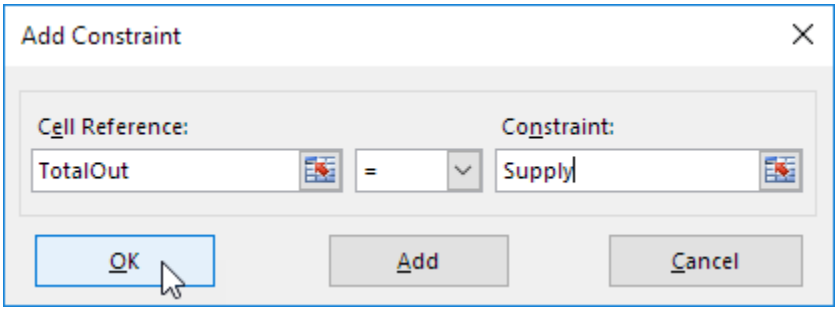
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

4. Enter Shipments for the Changing Variable Cells.

5. Click Add to enter the following constraint.



6. Click Add to enter the following constraint.



7. Check 'Make Unconstrained Variables Non-Negative' and select 'Simplex LP'.

8. Finally, click on Answer in the Reports category. Then click on Solve.

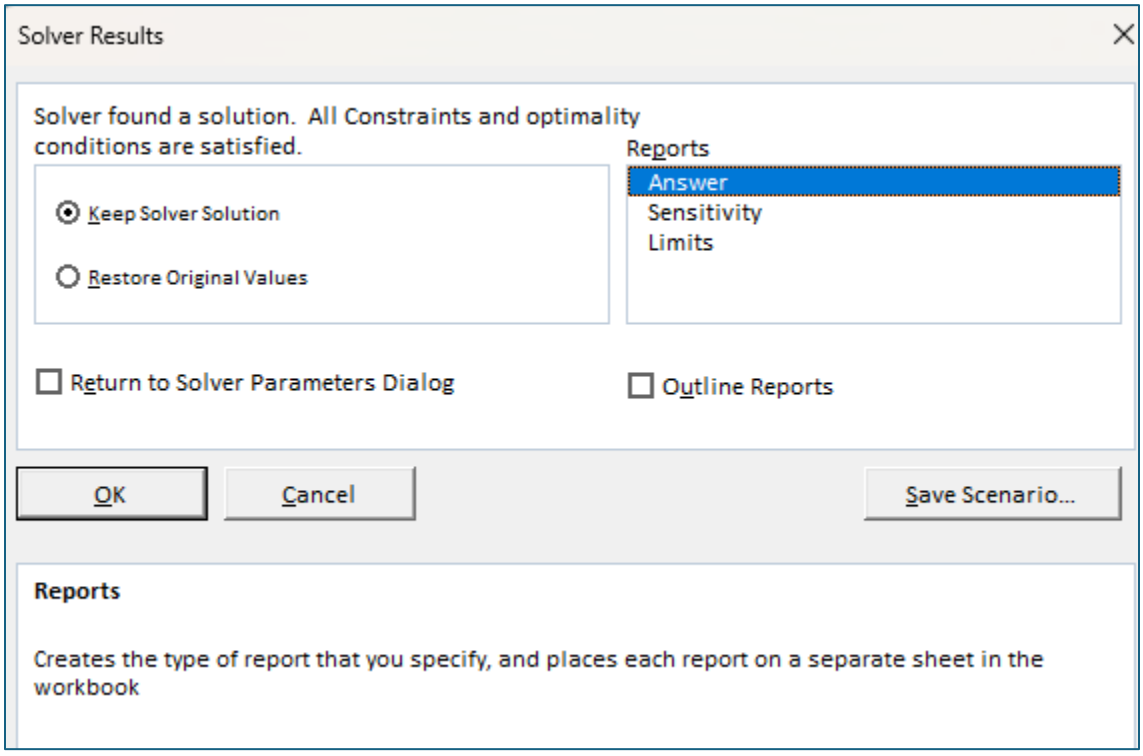


Figure 14: Image of Solver Results with Answer Report selected

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Result: The optimal solution:

	A	B	C	D	E	F	G	H	I	J
1		Transportation Problem								
2										
3		Unit Cost	Customer 1	Customer 2	Customer 3					
4		Factory 1	40	47	80					
5		Factory 2	72	36	58					
6		Factory 3	24	61	71					
7										
8										
9		Shipments	Customer 1	Customer 2	Customer 3		Total Out		Supply	
10		Factory 1	0	100	0		100	=	100	
11		Factory 2	0	100	100		200	=	200	
12		Factory 3	200	0	100		300	=	300	
13										
14		Total In	200	200	200					
15			=	=	=				Total Cost	
16		Demand	200	200	200				26000	
17										

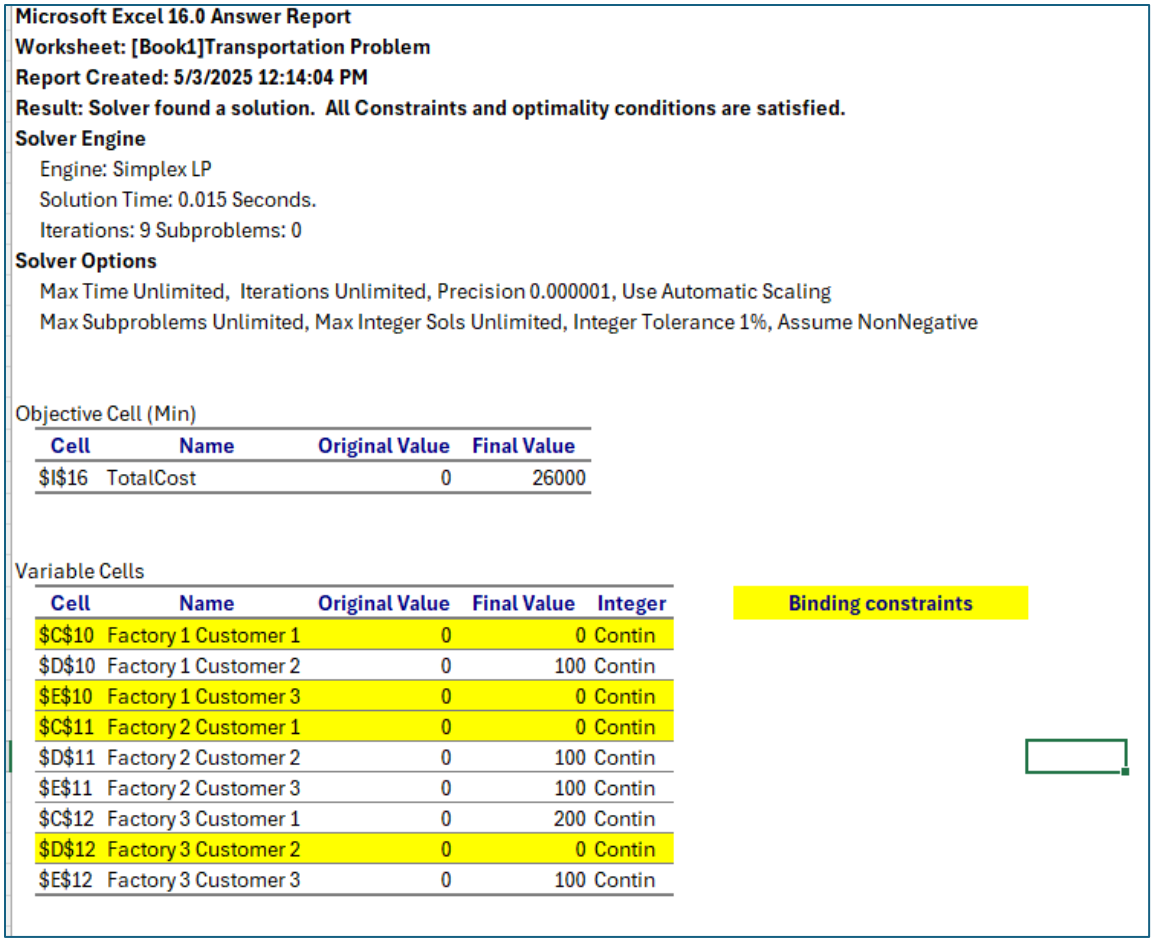
Figure 15: Transportation Problem Solution

Conclusion: it is optimal to ship 100 units from Factory 1 to Customer 2, 100 units from Factory 2 to Customer 2, 100 units from Factory 2 to Customer 3, 200 units from Factory 3 to Customer 1 and 100 units from Factory 3 to Customer 3. This solution gives the minimum cost of 26000. All constraints are satisfied.

6.8 Interpreting the Answer Report

The answer report created when a solution is found will show the binding constraints in the problem. To find a different solution, the constraints would need to be changed.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International



Microsoft Excel 16.0 Answer Report
Worksheet: [Book1]Transportation Problem
Report Created: 5/3/2025 12:14:04 PM
Result: Solver found a solution. All Constraints and optimality conditions are satisfied.
Solver Engine
Engine: Simplex LP
Solution Time: 0.015 Seconds.
Iterations: 9 Subproblems: 0
Solver Options
Max Time Unlimited, Iterations Unlimited, Precision 0.000001, Use Automatic Scaling
Max Subproblems Unlimited, Max Integer Sols Unlimited, Integer Tolerance 1%, Assume NonNegative

Objective Cell (Min)

Cell	Name	Original Value	Final Value
$I$16	TotalCost	0	26000

Variable Cells

Cell	Name	Original Value	Final Value	Integer
$C$10	Factory 1 Customer 1	0	0	Contin
$D$10	Factory 1 Customer 2	0	100	Contin
$E$10	Factory 1 Customer 3	0	0	Contin
$C$11	Factory 2 Customer 1	0	0	Contin
$D$11	Factory 2 Customer 2	0	100	Contin
$E$11	Factory 2 Customer 3	0	100	Contin
$C$12	Factory 3 Customer 1	0	200	Contin
$D$12	Factory 3 Customer 2	0	0	Contin
$E$12	Factory 3 Customer 3	0	100	Contin

Binding constraints

Figure 16: Answer Report

If constraints allow, the solver model can be adapted to produce different results. Solver is an excelent tool for performing what if analysis.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Chapter Assignments and Tests.

To assess your understanding of the material covered in the chapter, please complete the following assignments.

UNIQUE, SORT, FILTER, DROP-DOWNS

Isabelle's News has 5 stores located in the Portland airport. She wants a way to easily manipulate her sales data. She has given you the data from Jan 1, 2025 through 6/30/2025. You will design different worksheets to give her options on how she can select and filter her data.

For each step in the problem, create a new worksheet in the workbook by copying the RawData worksheet. All copied worksheets and created worksheets must be to the right of the Raw Data or previous step worksheet. Rename the worksheet tab with the step number. Rename the table on the new worksheet copy to reflect what you're working on.

Each row in the data contains the transaction date, salesperson, product sold, units sold, revenue, and shop location. In all cases, make sure your answers will automatically update if new data is added.

1. Create a copy of the Raw Data worksheet. Rename the new worksheet tab Dynamic Data. Rename the copied table tbl_Unique.
2. Create a new worksheet and rename it Dynamic Data. Move it to the right of the Step 1 worksheet.
3. On the Dynamic Data 1 worksheet in cell A2 create a unique list of salespeople from the RawData[Salesperson] data. Sort the salespeople alphabetically in ascending order using the SORT function.
4. In D2, create a new sorted list for Location.
5. Create a new worksheet and name it Sales by Salesperson:
    a. In cell A2 type Salesperson:
    b. In cell B2 create a data validation list from the unique salespeople list.
    c. In cell A4 Copy the headers from the tbl_Unique worksheet and paste them in A4.
    d. Use a FILTER to create a filtered list by the salesperson selected in B2.
    e. Create a title for your Sales by Salesperson worksheet.
6. Create a new worksheet and name it Sales by location. Move it to the right of the Sales by Salesperson worksheet.
    a. In cell A2 type Location:
    b. In cell B2 create a data validation list from the unique location list.
    c. In cell A4 Copy the headers from the tbl_Unique worksheet and paste them in A4.
    d. Use a FILTER to create a filtered list by location selected in B2.
    e. Create a title for your Sales by Location worksheet

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Solver Skills Review

You're a factory manager at Marvelous Manufacturing, Inc. The start-up company makes two products: A and B. Each uses a limited number of machine hours and materials. The company is analyzing the product mix that will maximize their profit.

Product	Profit per Unit	Machine Hours/Unit	Material/Unit
A	$30	2	3
B	$20	1	2

Constraints:

- Total machine hours available: 100
- Total material available: 120

Since the company wants to maximize their profit, how many of each product should they produce?

7. Use the SUMPRODUCT in cells C6 and D6 to calculate the total materials used.
8. Use the SUMPRODUCT in cell E12 to calculate total profit.
9. Use Sum to calculate total units produced.
10. Name cells
    a. C6: Machine Hours Used,
    b. D6:Materials Used
    c. E12: Total Proft
    d. D9: Machine Hours Avail.
    e. D10 Materials Avail.
11. Set up the Solver model using the constraints given.
    a. Set your objective cell
    b. Determine your changing cells.
    c. Determine what you are solving for.
    d. Set the integer constraint because you can't make partial products.

When you find a feasible solution, create an answer report and show the binding constraints. Explain what you might change to increase profit.

Solver Case Study

American Valve Company (AVC), is a manufacturing company that produces industrial valves. As the operations manager, you need to determine the production schedule for manufacturing

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

three valves in the new 102 Series, which is used in hydroelectric production. Producing the 102 Series valves is a three-part process. During the casting phase, the body of the valve and some of the attaching pieces are created. During the machining phase, the casting surfaces are finished, and the inner valve flange is created. Finally, during the last phase, the valves are assembled and inspected.

The plant manager provided you with a workbook that contains the production times for each production phase, and the unit cost and list price for ach 102 Series valve. The plant manager also told you that your time is limited to 500 hours in the Casting Department, 500 hours in the Machining Department, and 100 hours in the Final Assembly Department. No more time is available in these departments. The workbook also includes the setup costs associated with a production run for each valve. You must account for these costs in the profit amounts for each valve.

Based on the historical demand for these valves, the company has a policy that any single valve in the 102 Series should constitute at least 10% of the production run and that no single valve should constitute more than 50% of the total production time. Your goal is to maximize the total profit of producing these valves while not exceeding the time available in each department. Make sure that your solution is only solving for whole numbers. (Do not round)

Complete the following:

1. Enter a SUM function in the objective cell.
2. Enter formulas to link the Profit cells with the variable cells. (Number produced * (List Price -Unit cost)-Set-up Cost) Add sample values to the variable cells to ensure that your worksheet is set up correctly and produces the expected results. (Hint: Use a 1 for each valve in the units produced.)
3. Name the following ranges in the Production Time per Unit area:
   - Total production time for each department
     i. C9: CastingUsed
     ii. D9: MachiningUsed
     iii. E9: FinalAssUsed
4. Name the Number Produced range H5:H7 NumProduced
5. In C9:D9, create the formulas that calculate the total production time used for casting, machining, and final assembly. (Use SUMPRODUCT)
6. Name the total profit cell I8: TotalProfit
7. Create a constraints table starting in cell A12 in the worksheet that identifies the constraints in this problem.. Your constraint name should be in the A column, and the named constraint should be in the B column. Name the relevant constraint cells in the B column:
   - Constraints table variables
     i. A12: CastingAvail
     ii. A13: MachiningAvail
     iii. A14: FinalAssAvail

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

iv. A15: MinPercent
v. A16:MaxPercent

8. Use Solver to determine the optimal combination of valves to build to maximize profit. Remember that you can only make whole valves.)
9. Use the named cells and ranges to produce your Solver model.
10. Produce an answer report for your solution. Highlight which constraints could be modified to maximize total profit? Place your recommendation in a text box on the Answer Report worksheet.
11. In cell A1 of the Valve Production worksheet insert: ACV New Valve Series Production Schedule Estimate.
12. Save your solution.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Legacy Excel Functions

Legacy LOOKUP Functions:

The VLOOKUP Function

Follow-along file: Continue with Excel Objective 3.00. (Use file Excel Objective 3.15 if starting here.)

The VLOOKUP function is typically used to access and display data located in another worksheet or workbook. The function can also be used to access and display data located in the same worksheet. This is a very powerful and versatile function because it eliminates the need to copy or recreate data that exists in other worksheets or workbooks.

It is called a *V*LOOKUP function because the function will search *v*ertically down the first column of a range of cells to find what is called a lookup value. This process is very similar to the statistical IF functions in Section 3.2 "Statistical IF Functions". You will recall that these functions used criteria to select cells from a range that was used in the mathematical output. The VLOOKUP function is essentially performing the same process; however, instead of selecting multiple cells from a range, the function is only looking for one specific cell location. Once the function finds the specific cell location, it will display the contents of that cell location or another cell location in the range.

Before using the VLOOKUP function in the personal investment portfolio workbook, it is strongly recommended that you carefully read the definitions for the function arguments listed in Table 3.10 "Arguments for the VLOOKUP Function".

=VLOOKUP(lookup_value,table_array,row_index_num,[range_lookup])

Table 3.11 Arguments for the VLOOKUP Function

Argument	Definition
Lookup_value	This argument is typically defined with a cell location, number, or text. Text data must be enclosed in quotation marks for this argument. The function will search for the criteria in the *first column* of the range used to define the **Table_array** argument. For example, if the word *Hat* is used to define this argument, the function will always search for the word *Hat* in the first column of the range used to define the **Table_array** argument.
Table_array	A range of cells that contain data you wish the VLOOKUP function to search though (Lookup_value) and display. This cell range *must*

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

	contain the criteria used to define the **Lookup_value** in the first column.
Col_index_num	This is the column index number argument. It is defined as the number of columns to the right of the first column in the range used to define the **Table_array.,** argument that contains the data you wish to display. For example, suppose the data you wish the function to display is contained in Column C. If the range used to define the **Table_array** argument is A2:D15, then the column index number will be 3. Counting the columns to the right of the first column in this range, Column A would be 1, Column B would be 2, and Column C would be 3. It is important to remember to count the first column in the table array range as 1.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

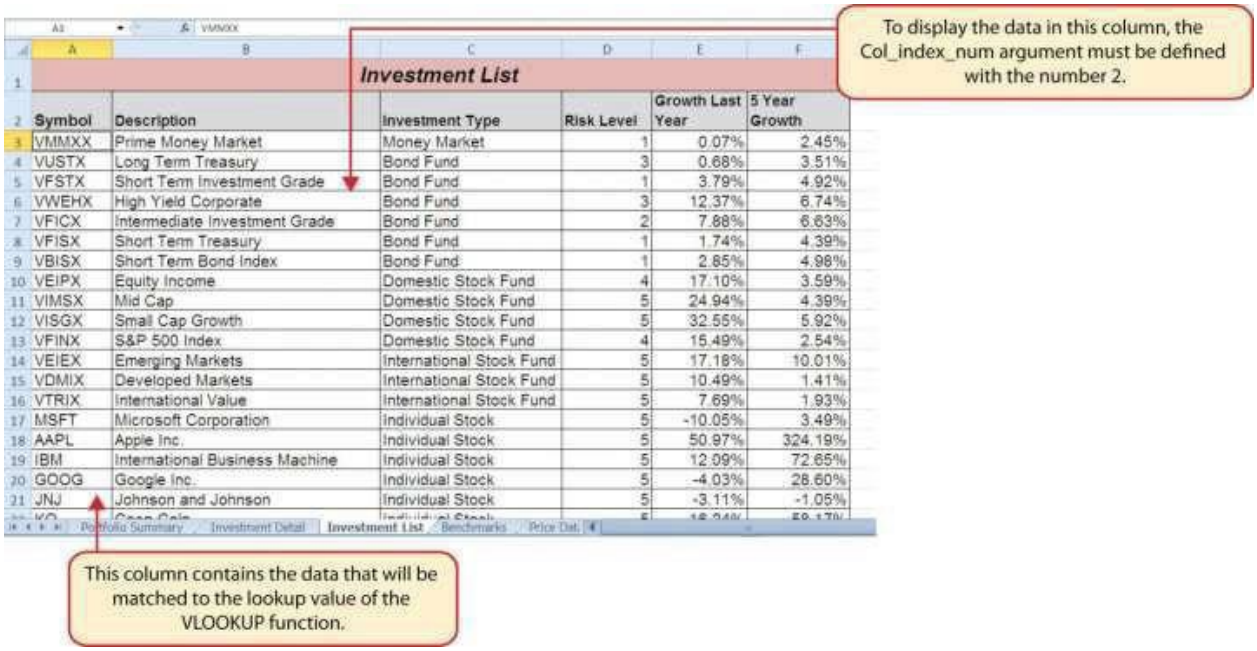
[Range_lookup]	This argument is defined with either the word *TRUE* or the word *FALSE*. When this argument is defined with the word *FALSE*, the function will look for an exact match to the criteria used to define the **Lookup_value** argument in the first column of the table array range. It is important to note the function will search the entire range to find an exact match. If this argument is defined with the word *TRUE*, the function will look for a value that is an exact match or the closest match that is *less than* the lookup value. Examples: If f the lookup value is 80 and the highest value in the first column of the table array range is a 78, the function will consider 78 a match for the number 80. If the lookup value is 78 and the range is 70,80,90,100, The function will consider 78 to be a match for 70 (the lower value). However, if the lookup value is 80 and the lowest number in the first column of the table array range is 85, the function will produce an error. This is because the number 80 and any value less than 80 do not exist in the first column of the table array range. *It is important to note that if you define this argument with the word TRUE, the data in the table array range must be sorted in ascending order.* This is because the function will stop searching for a match once the value in the first column exceeds the lookup value. If the data in the table array range is not sorted, the function can either produce an error code or display an erroneous result. This argument is in brackets because if it is not defined it will automatically be defined with the word *TRUE*.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Integrity Check
Using a TRUE Range Lookup for VLOOKUP and HLOOKUP If you are defining the **Range_lookup** argument with the word *TRUE* for either the VLOOKUP or HLOOKUP function, the range used to define the **Table_array** argument must be sorted in ascending order. For the VLOOKUP function, the table array range must be sorted from smallest to largest or from A to Z based on the values in the first column. For the HLOOKUP function, the table array range must be sorted from left to right based on the values in the first row, from smallest to largest or A to Z.

You may have noticed that on the **Investment Detail** worksheet, the Description column is blank. Descriptions for several investments are included in the workbook in the **Investment List** worksheet as shown in Figure 3.42 "Investment List Worksheet". The VLOOKUP function will be used to search for a specific symbol in Column A of the Investment List worksheet and display the description for that symbol located in Column B. It is important to note that once the Table_array has been defined, the VLOOKUP can return any column number within that array. For example, to return the investment type you would select column 3. For 5-year growth, you would select column 6.

Figure 3.42 Investment List Worksheet


To display the data in this column, the Col_index_num argument must be defined with the number 2.
Investment List
Symbol
Description
Investment Type
Risk Level
Growth Last Year
5 Year Growth
VMMXX Prime Money Market Money Market 1 0.07% 2.45%
VUSTX Long Term Treasury Bond Fund 3 0.68% 3.51%
VFSTX Short Term Investment Grade Bond Fund 1 3.79% 4.92%
VWEHX High Yield Corporate Bond Fund 3 12.37% 6.74%
VFICX Intermediate Investment Grade Bond Fund 2 7.88% 6.63%
VFISX Short Term Treasury Bond Fund 1 1.74% 4.39%
VBISX Short Term Bond Index Bond Fund 1 2.85% 4.98%
VEIPX Equity Income Domestic Stock Fund 4 17.10% 3.59%
VIMSX Mid Cap Domestic Stock Fund 5 24.94% 4.39%
VISGX Small Cap Growth Domestic Stock Fund 5 32.55% 5.92%
VFINX S&P 500 Index Domestic Stock Fund 4 15.49% 2.54%
VEIEX Emerging Markets International Stock Fund 5 17.18% 10.01%
VDMIX Developed Markets International Stock Fund 5 10.49% 1.41%
VTRIX International Value International Stock Fund 5 7.69% 1.93%
MSFT Microsoft Corporation Individual Stock 5 -10.05% 3.49%
AAPL Apple Inc. Individual Stock 5 50.97% 324.19%
IBM International Business Machine Individual Stock 5 12.09% 72.65%
GOOG Google Inc. Individual Stock 5 -4.03% 28.60%
JNJ Johnson and Johnson Individual Stock 5 -3.11% -1.05%
Portfolio Summary
Investment Detail
Investment List
Benchmarks
Price Dat
This column contains the data that will be matched to the lookup value of the VLOOKUP function.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Creating a Table_array:

To create a Table_array we will use the Investment List from the Investment List worksheet.

The following steps explain how to accomplish this:

26. First, we will create a named range.
27. Click on the Investment List worksheet.
28. Select the range A3:F23 (this range excludes the worksheet title.)
29. In the Name box type in Investment_List. Notice that the Refers to: box at the bottom shows the worksheet name and range of cells this name will apply to. Make sure it shows the correct range. The $ indicates that naming this range will create an absolute reference to these cells in your workbook.
30. In the Investment Detail worksheet, click on cell C4.
31. Click the Formulas tab on the Ribbon.
32. Click the Lookup & Reference button in the Function Library group of commands.
33. Select the VLOOKUP function from the list of functions. Use the scroll bar to scroll down to the bottom of the list. This will open the Function Arguments dialog box for the VLOOKUP function.
34. Click in the **Lookup_value** argument on the Function Arguments dialog box.
35. Click cell B4. The symbol in cell B4 is the lookup value that will be searched in the first column of the range defined for the **Table_array** argument.
36. Click in the **Table_array** argument on the Function Arguments dialog box.
37. From the Formulas ribbon click on Use in Formula and select Investment_List.
38. Press the TAB key on your keyboard to advance to the **Col_index_num** argument and type the number **2**. Once the function finds the lookup value in the first column of the range Investment_List, it will display the description that is in the second column of the same row.
39. Press the TAB key on your keyboard to advance to the **Range_lookup** argument and type the word **FALSE**. This will direct the function to search for only exact matches to lookup value.
40. Click the OK button at the bottom of the Function Arguments dialog box.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

41. Copy the VLOOKUP function in cell C4 and paste it into the range C5:C18

Figure 3.43 "Completed Function Arguments Dialog Box for the VLOOKUP Function" shows the completed Function Arguments dialog box for the VLOOKUP function. Notice that the Range_lookup argument is defined with the word *FALSE*. This will direct the function to search for an exact match to the lookup value and will also direct the function to search the entire first column of the table array range.

Finally, it is important to note the absolute reference on the table array range. This will prevent the table array range from changing when the function is pasted into other cell locations.

Figure 3.43 Completed Function Arguments Dialog Box for the VLOOKUP Function

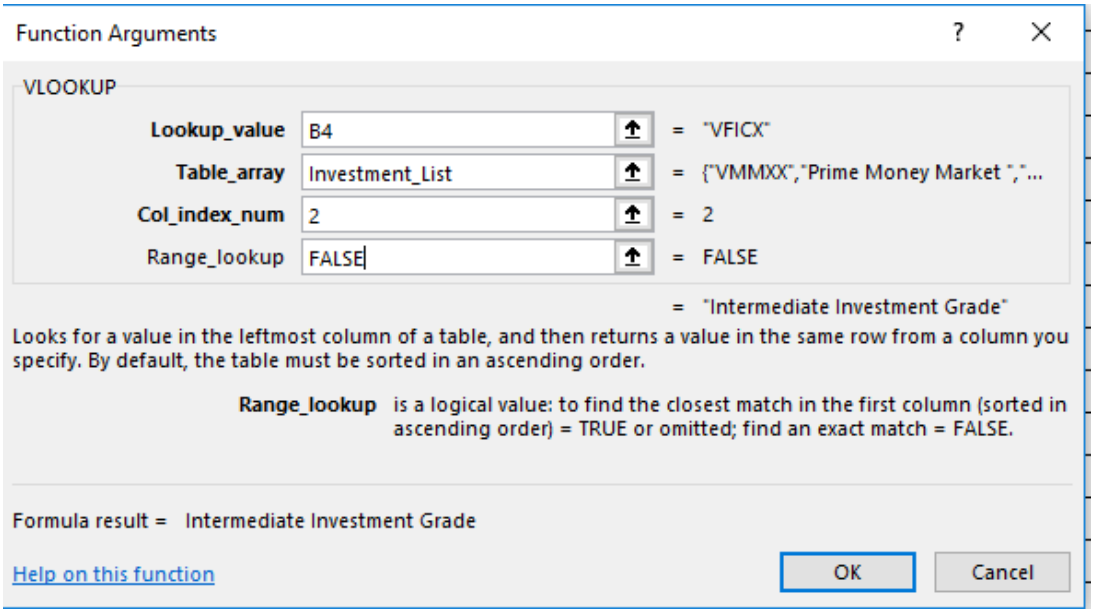

Function Arguments
VLOOKUP
Lookup_value
B4
= "VFICX"
Table_array
Investment_List
= {"VMMXX","Prime Money Market ","...
Col_index_num
2
= 2
Range_lookup
FALSE
= FALSE
= "Intermediate Investment Grade"
Looks for a value in the leftmost column of a table, and then returns a value in the same row from a column you specify. By default, the table must be sorted in an ascending order.
Range_lookup is a logical value: to find the closest match in the first column (sorted in ascending order) = TRUE or omitted; find an exact match = FALSE.
Formula result = Intermediate Investment Grade
Help on this function
OK
Cancel

Figure 3.44 "Results of the VLOOKUP Function in the Investment Detail Worksheet" shows the results of the VLOOKUP function in the **Investment Detail** worksheet. The function is searching for each symbol in Column B of the **Investment Detail** worksheet in Column A of the **Investment List** worksheet.

When the function finds a match, it will display whatever is in the cell location two columns to the right, or Column B, in the **Investment List** worksheet. For example, the symbol VDMIX, which is in cell B8 on the **Investment Detail** worksheet (see Figure 3.44 "Results of the VLOOKUP Function in the Investment Detail Worksheet"), is also in cell A15 on the **Investment List** worksheet. As a result, the function is displaying whatever is in cell B15 on the **Investment List** worksheet, which is the description “Developed Markets.”

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.44 Results of the VLOOKUP Function in the Investment Detail Worksheet

=VLOOKUP(B4,'Investment List'!$A$3:$F$23,2,FALSE)
VLOOKUP function as it appears in cell C4.
This description is in cell B15 on the Investment List worksheet.

Personal Investment Portfolio

	Descriptive Information				Purchase		
3	Investment Type	Symbol	Description	Dividend / Yield	Shares Purchased	Purchase Price per Share	Cost o Purch
4	Bond Fund	VFICX	Intermediate Investment Grade	4.60%	750	$ 9.49	$ 7
5	Bond Fund	VFSTX	Short Term Investment Grade	3.20%	750	$ 10.68	$ 8
6	Bond Fund	VWEHX	High Yield Corporate	7.20%	500	$ 6.29	$ 3
7	Bond Fund	VUSTX	Long Term Treasury	4.00%	500	$ 11.00	$ 5
8	International Stock Fund	VDMIX	Developed Markets	2.60%	500	$ 14.68	$ 7
9	Domestic Stock Fund	VEIPX	Equity Income	2.50%	500	$ 23.35	$ 11
10	Domestic Stock Fund	VISGX	Small Cap Growth	0.30%	250	$ 19.33	$ 4
11	Domestic Stock Fund	VIMSX	Mid Cap	1.00%	250	$ 22.41	
12	International Stock Fund	VTRIX	International Value	2.00%	250	$ 22.83	
13	International Stock Fund	VEIEX	Emerging Markets	1.40%	250	$ 23.74	$ 5
14	Individual Stock	TRV	The Travelers Companies, Inc.	2.40%	150	$ 38.14	$ 5
15	Individual Stock	JNJ	Johnson and Johnson	3.60%	150	$ 53.30	$ 7
16	Individual Stock	KO	Coca Cola	2.80%	150	$ 62.46	$ 9
17	Individual Stock	MSFT	Microsoft Corporation	2.50%	75	$ 28.02	$ 2
18	Individual Stock	IBM	International Business Machine	1.60%	75	$ 87.68	$ 6
19	*Total*				5,100		$ 96

Portfolio Summary | Investment Detail | Investment List | Benchmarks | Price Dat

Integrity Check - Absolute References on the Table Array Range for the VLOOKUP and HLOOKUP Functions

If you have not named your Table_array for the VLOOKUP or HLOOKUP functions and will be copying and pasting the VLOOKUP or HLOOKUP function, you will most likely need to place an absolute reference on the range used to define the **Table_array** argument. If you do not, the table array range will change because of relative referencing once the function is pasted to new cell locations. This could result in an error output for either the VLOOKUP or HLOOKUP function. This is because the function will not be able to find the lookup value since the range has been adjusted. If you are defining the **Range_lookup** argument with the word *TRUE*, an adjustment in the table array range may result in an erroneous output.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Skill Refresher -VLOOKUP

5. Type an equal sign (=).
6. Type the function name VLOOKUP followed by an open parenthesis (().
7. Define the Lookup_value argument with a cell location, number, or text that will be searched in another workbook or worksheet. Text must be placed in quotation marks.
8. Type a comma.
9. Define the lookup_array argument with a range of cells that contain the lookup value in the first column along with data that is to be displayed or used by the function.
10. Type a comma.
11. Define the Col_index_num argument with a number that designates the columns to the right in the table array range that will be displayed by the function. Count the first column of the table array range as 1.
12. Type a comma.
13. Define the Range_lookup argument with either the word *FALSE* or the word *TRUE*. The word *FALSE* will search for exact matches to the lookup value. The word *TRUE* will search for an exact or closest match less than the lookup value. Excel will define this argument as TRUE if it is omitted.
14. Type a closing parenthesis).
15. Press the ENTER key on your keyboard

The HLOOKUP Function

Follow-along file: Continue with Excel Objective 3.00. (Use file Excel Objective 3.15 if starting here.)

The HLOOKUP function serves the same purpose as the VLOOKUP function. The HLOOKUP function can be used to display data from another worksheet or workbook. However, instead of searching for the lookup value vertically down the first column of the table array range, the HLOOKUP function searches horizontally across the *first row* of the table array range. When the function finds a match for the lookup value, it will display the contents in a cell location based on a row index number. This number designates which row in the table array range the function should display.

=HLOOKUP(lookup_value,table_array,row_index_num,[range_lookup])

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Table 3.11 "Arguments for the HLOOKUP Function" provides a definition for each argument of the HLOOKUP function. It is best to review the definitions of these arguments carefully before using the function.

Table 3.11 Arguments for the HLOOKUP Function

Argument	Definition
Lookup_value	This argument is typically defined with a cell location, number, or text. Text data must be enclosed in quotation marks for this argument. The function will search for the criteria entered into this argument in the *first row* of the range used to define the **Table_array** argument. For example, if the word *Hat* is used to define this argument, the function will search for the word *Hat* in the first row of the range used to define the **Table_array** argument.
Table_array	Range of cells that contain data you wish the HLOOKUP function to search though (Lookup_value) and display. This cell range *must* contain the criteria used to define the **Lookup_value** in the first row. For example, if the range A2:D15 is used to define this argument, the criteria used to define the **Lookup_value** argument must exist in Row 2.
Row_index_num	This is the row index number argument. It is defined with the number of rows below the first row in the range used to define the **Table_array** argument that contains the data you wish to display. For example, suppose the data you wish the function to display is contained in Row 5. If the range used to define the **Table_array** argument is A2:D15, then the column index number will be 4. Counting the rows below the first row in this range, Row 2 would be 1, Row 3 would be 2, Row 4 would be 3, and Row 5 would be 4. It is important to remember to count the first row in the table array range as 1.

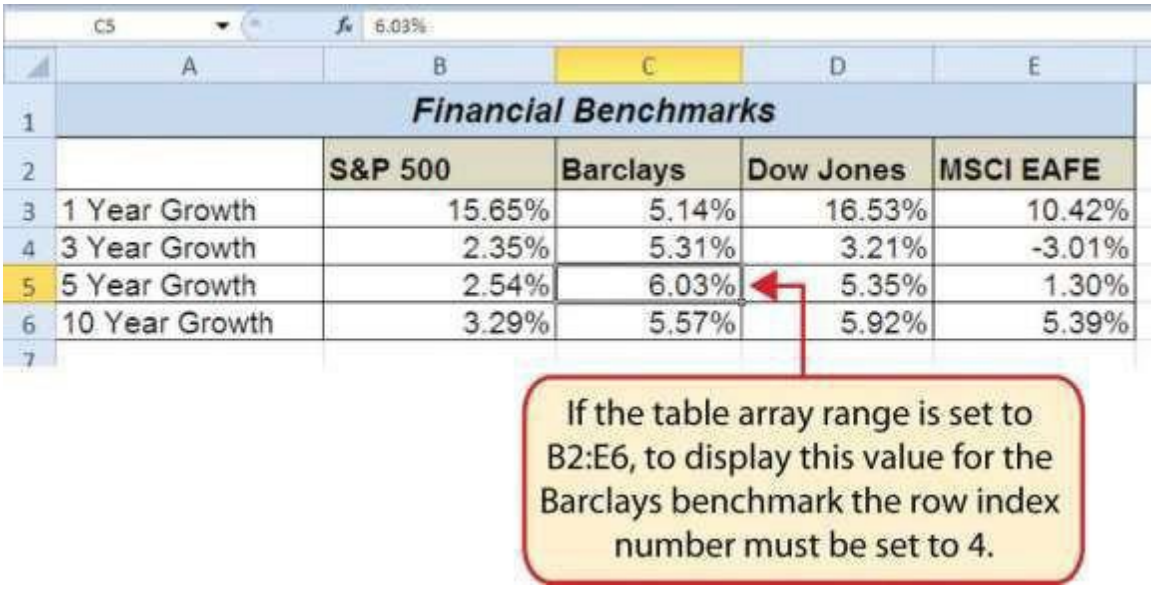
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Argument	Definition
[Range_lookup]	This argument is defined with either the word *TRUE* or the word *FALSE*. When this argument is defined with the word *FALSE*, the function will look for an exact match to the criteria used to define the **Lookup_value** argument in the first row of the table array range. It is important to note the function will search the entire range to find a match. If this argument is defined with the word *TRUE*, the function will look for a value that is an exact match or the closest match that is *less than* the lookup value. For example, if the lookup value is 80 and the highest value in the first row of the table array range is 78, the function will consider 78 a match for the number 80. However, if the lookup value is 80 and the lowest number in the first row of the table array range is 85, the function will produce an error. This is because the number 80 and any value less than 80 do not exist in the first row of the table array range. *It is important to note that if you define this argument with the word TRUE, the data in the table array range must be sorted based on the values in the first row in ascending order from left to right.* This is because the function will stop searching for a match once the value in the first row exceeds the lookup value. If the data in the table array range is not sorted, the function can either produce an error code or display an erroneous result. This argument is in brackets because if it is not defined it will automatically be defined with the word *TRUE*.

The HLOOKUP function will be used on the **Portfolio Summary** worksheet to display the benchmark growth rates in the range G4:G7. A benchmark is a value that can be used as a standard point of comparison. The **Benchmarks** worksheet contains growth rates at different year intervals for the benchmarks that will be used to compare the performance for each investment type (see Figure 3.45 "Benchmarks Worksheet"). For the purposes of this workbook, we will be comparing the growth rates for each investment type to the 5- year average growth rate for the benchmarks categories listed in the range H4:H7. The following steps explain how to construct the HLOOKUP function to display the 5-year benchmark values in the **Portfolio Summary** worksheet:

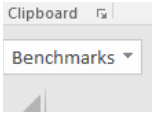
Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Figure 3.45 Benchmarks Worksheet


C5
6.03%
Financial Benchmarks
S&P 500
Barclays
Dow Jones
MSCI EAFE
1 Year Growth 15.65% 5.14% 16.53% 10.42%
3 Year Growth 2.35% 5.31% 3.21% -3.01%
5 Year Growth 2.54% 6.03% 5.35% 1.30%
10 Year Growth 3.29% 5.57% 5.92% 5.39%
If the table array range is set to B2:E6, to display this value for the Barclays benchmark the row index number must be set to 4.

Go to the Benchmarks worksheet by clicking on the Benchmarks tab.

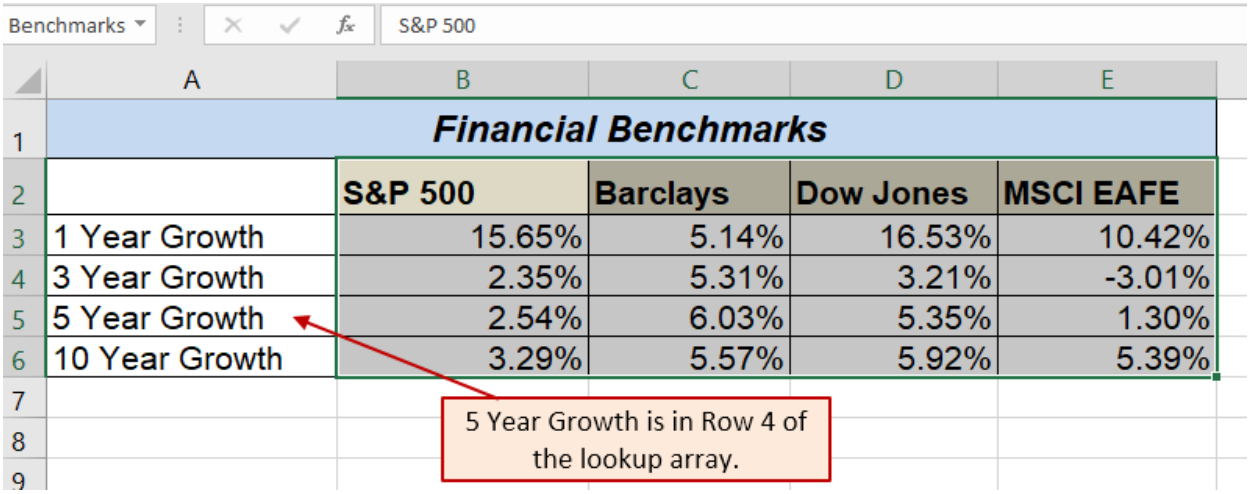
16. We will name the Benchmarks range for use in the HLOOKUP function. The range we will name is B2:E6. The top row contains the look up values the function will use to find a match. The remaining rows will be the results returned once a match is found.
17. Highlight B3:B6 and name the range Benchmarks by typing the name in the Cell address block on the left side of the formula bar.



18. Click cell G4 in the Portfolio Summary worksheet.
19. Click the Formulas tab on the Ribbon.
20. Click the Lookup & Reference button in the Function Library group of commands.
21. Select the HLOOKUP function from the list of functions. This will open the Function Arguments dialog box for the HLOOKUP function.
22. Click in the **Lookup_value** argument on the Function Arguments dialog box.
23. Click cell H4. The description in cell H4 will be the lookup value that will be searched in the first row of the range defined for the **Table_array** argument.
24. Click in the **Table_array** argument on the Function Arguments dialog box.
25. From the Formulas ribbon, Use in Formula, select the named range Benchmarks.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

26. Press the TAB key on your keyboard to advance to the **Row_index_num** argument and type the number **4**.



Remember that the Excel row number from the left side of the worksheet window is irrelevant in table arrays. It is the number of rows in the array itself that are counted.

27. Press the TAB key on your keyboard to advance to the **Range_lookup** argument on the Function Arguments dialog box and type the word **FALSE**. This will direct the function to search for **only exact matches** of the lookup value. Without an exact match, the results may be erroneous because Excel will stop looking when it finds an approximate match, or one higher in value.
28. Click the OK button at the bottom of the Function Arguments dialog box.
29. Copy the HLOOKUP function in cell G4 and paste it into the range G5:G7 using the Paste Formulas command.

Figure 3.46 "Completed Function Arguments Dialog Box for the HLOOKUP Function" shows the completed Function Arguments dialog box for the HLOOKUP function. The row index number 4 indicates that the function will display the contents of the cell location in the fourth row of the table array range.

Figure 3.46 Completed Function Arguments Dialog Box for the HLOOKUP Function

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

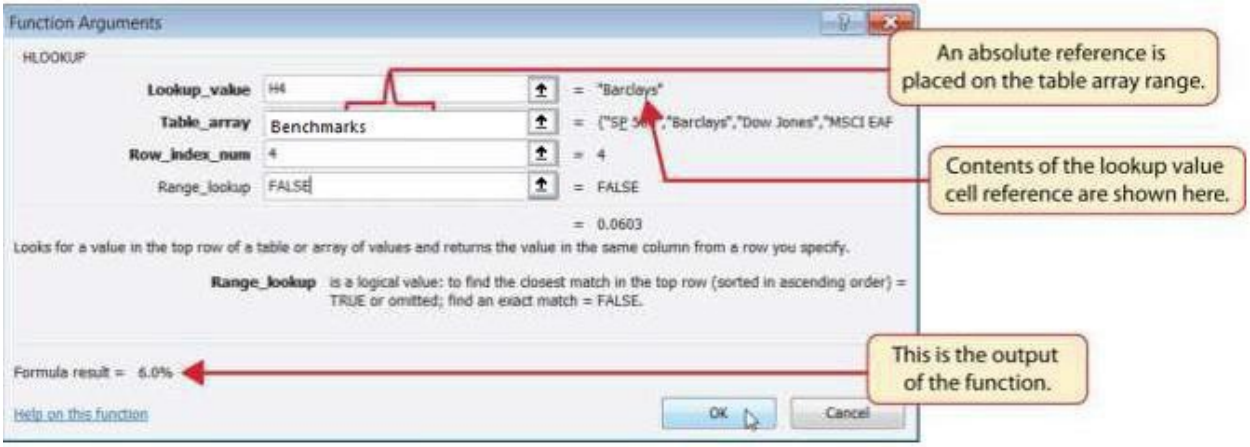
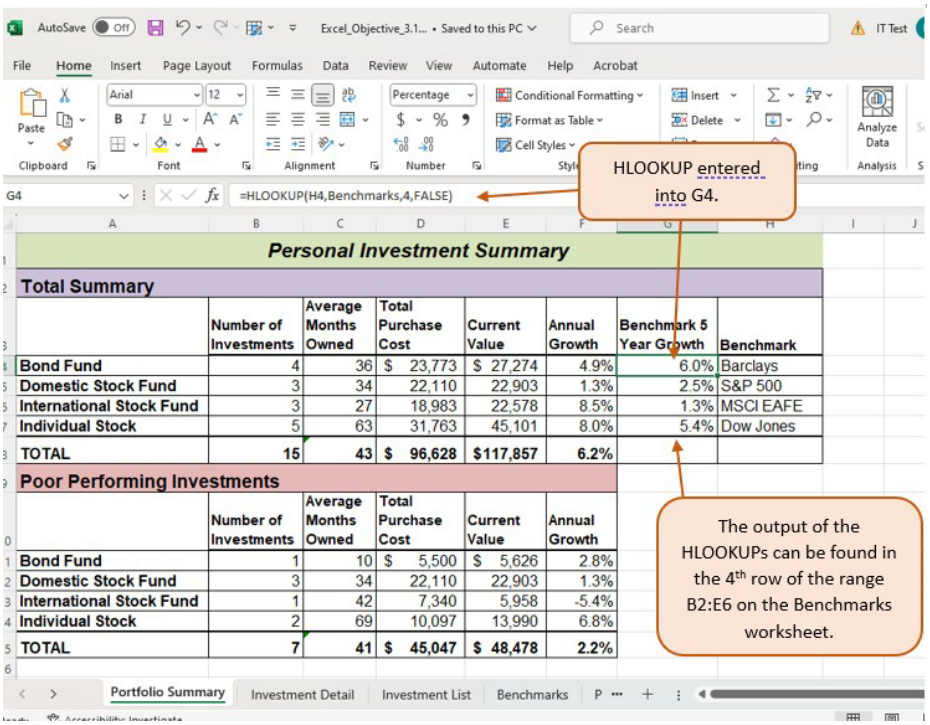

Function Arguments
HLOOKUP
Lookup_value H4 = "Barclays"
Table_array Benchmarks = {"S&P 500","Barclays","Dow Jones","MSCI EAF
Row_index_num 4 = 4
Range_lookup FALSE = FALSE
= 0.0603
Looks for a value in the top row of a table or array of values and returns the value in the same column from a row you specify.
Range_lookup is a logical value: to find the closest match in the top row (sorted in ascending order) = TRUE or omitted; find an exact match = FALSE.
Formula result = 6.0%
Help on this function
OK
Cancel
An absolute reference is placed on the table array range.
Contents of the lookup value cell reference are shown here.
This is the output of the function.

Figure 3.47 "Completed Portfolio Summary Worksheet" shows the output of the HLOOKUP function. Notice that the output of the function in cell G4 is 6.0%. This is because the lookup value was defined with the entry in cell H4, which is the Barclays index. Looking at Figure 3.45 "Benchmarks Worksheet", if you count the first row of the table array range as Row 1, the value 6.03% is the fourth row in the Barclays column. Since the values in Column G on the **Portfolio Summary** worksheet are set to 1 decimal place, the value is displayed as 6.0%.

Figure 3.47 Completed Portfolio Summary Worksheet


HLOOKUP entered into G4.
=HLOOKUP(H4,Benchmarks,4,FALSE)
Personal Investment Summary
Total Summary
Number of Investments | Average Months Owned | Total Purchase Cost | Current Value | Annual Growth | Benchmark 5 Year Growth | Benchmark
Bond Fund 4 36 $ 23,773 $ 27,274 4.9% 6.0% Barclays
Domestic Stock Fund 3 34 22,110 22,903 1.3% 2.5% S&P 500
International Stock Fund 3 27 18,983 22,578 8.5% 1.3% MSCI EAFE
Individual Stock 5 63 31,763 45,101 8.0% 5.4% Dow Jones
TOTAL 15 43 $ 96,628 $117,857 6.2%
Poor Performing Investments
Number of Investments | Average Months Owned | Total Purchase Cost | Current Value | Annual Growth
Bond Fund 1 10 $ 5,500 $ 5,626 2.8%
Domestic Stock Fund 3 34 22,110 22,903 1.3%
International Stock Fund 1 42 7,340 5,958 -5.4%
Individual Stock 2 69 10,097 13,990 6.8%
TOTAL 7 41 $ 45,047 $ 48,478 2.2%
The output of the HLOOKUPs can be found in the 4th row of the range B2:E6 on the Benchmarks worksheet.
Portfolio Summary
Investment Detail
Investment List
Benchmarks

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Integrity Check - #N/A and #REF! Errors with Lookup Functions

If you receive the **#N/A** error code when using the VLOOKUP or HLOOKUP function, it indicates that Excel cannot find the lookup value in the table array range. Check that the lookup value exists in the first column for the VLOOKUP, or the first row for the HLOOKUP, in the range used to define the **Table_array** argument. You may also see this error code if you copy and paste the function and forget to put an absolute reference on the range used to define the **Table_array** argument. The **#REF!** error code indicates that the column index number or row index number exceeds the number of columns or rows in the range used to define the **Table_array** argument.

Skill Refresher - HLOOKUP

1. Type an equal sign (**=**).
2. Type the function name **HLOOKUP** followed by an open parenthesis(**(**).
3. Define the **Lookup_value** argument with a cell location, number, or text that will be searched in another workbook or worksheet. Text must be placed in quotation marks.
4. Type a comma.
5. Define the **Table_array** argument with a range of cells that contain the lookup value in the first row along with data that is to be displayed or used by the function.
6. Type a comma.
7. Define the **Row_index_num** argument with a number that designates the rows from the top of the table array range that will be displayed by the function. Count the first row of the table array range as 1.
8. Type a comma.
9. Define the **Range_lookup** argument with either the word *FALSE* or the word *TRUE*. The word *FALSE* will search for exact matches to the lookup value. The word *TRUE* will search for an exact or closest match less than the lookup value. Excel will define this argument as TRUE if it is omitted.
10. Type a closing parenthesis **)**.
11. Press the ENTER key on your keyboard.

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International

Key Takeaways

- Lookup functions are powerful and versatile tools because they eliminate the need to copy or recreate data that exists in other worksheets or workbooks.
- The VLOOKUP function will look vertically down the first column of the table array range to find the lookup value. The lookup value must exist in the first column of the table array range when using the VLOOKUP function.
- The HLOOKUP function will look horizontally across the first row of the table array range to find the lookup value. The lookup value must exist in the first row of the table array range when using the HLOOKUP function.
- If the **Range_lookup** argument for the VLOOKUP function is defined with the word *TRUE*, the data in the table array range must be sorted in ascending order (smallest to largest) based on the values in the first column.
- If the **Range_lookup** argument for the HLOOKUP function is defined with the word *TRUE*, the data in the table array range must be sorted in ascending order (smallest to largest), left to right, based on the values in the first row.
- If you are copying and pasting a VLOOKUP or HLOOKUP function to other cell locations on a worksheet, make sure there is a named cell or an absolute reference placedon the table array range.
- IFERROR can be used in templates to hide the results of formulas that are in cells but not currently being used.

EXERCISES

1. Which of the following is true with respect to the range of cells used to define the lookup_array argument when using the XLOOKUP function?
   a. The lookup value must exist in the range.
   b. The lookup value must exist in the first column of the range.
   c. This range must be sorted in ascending order if the Range_lookup argument is defined with the word *FALSE*.
   d. The range used to define the lookup_array argument is the Lookup_value.
2. Assume that the range B3:E23 is used to define the Table_array argument for an HLOOKUP function. How should the Row_index_num argument be defined if the output of the function should be the contents of the cell location in Row 15 inthe same column as the lookup value?
   a. with the number 15
   b. with the range B3:B15
   c. with cell location B15
   d. with the number 13
3. Column A contains values that will be used to define the Lookup_value argument of a VLOOKUP function. The function will search for an exact match to the lookup value in the range A2:D15 in the **Description List** worksheet. The output of the function should be the contents in the cell location in Column C of the same row as the lookup value. Once the function is created, it will be copied and pasted to other cell locations in the same column. Which of the following VLOOKUP functions will provide an accurate result based on these criteria?
   a. =VLOOKUP(A4,'Description List'!A2:D15,2,FALSE)
   b. =VLOOKUP($A$4,'Description List'!$A$2:$D$15,2,FALSE)
   c. =VLOOKUP(A4,'Description List'!$A$2:$D$15,3,TRUE)
   d. =VLOOKUP(A4,'Description List'!$A$2:$D$15,3,FALSE)

Kaaren McGlynn (Adaptation): Attribution-Noncommercial-ShareAlike 4.0 International